ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 18, No. 12. WEEKLY. | NEW YORK, SATURDAY, MAY 16, 1891. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1891, by Electrical Review Publishing Company, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

Mr. Samuel Insull, second vice-president of the Edison General Electric Company and president of the New York Electric Club, in talking over early experiences with friends the other evening, said: "My first experience in telephone work was to send a cablegram from London to Mr. Edison, telling him that the Bell people in England were about to bring suit against the Edison receiver. In about two hours I received an answer from Mr. Edison, saying, 'Have invented another receiver.' It cost the English Bell Company many thousands of dollars."

A gang of pole-choppers in Wall street made use of a neat kink to prevent the asphalt paving from injury when a large pole toppled over. Several bales of old rags were so placed that the top of the pole struck them when it fell. The contrast between the anxiety to get the pole down and to save the street from harm was interesting.

John Stephenson, nearly 83 years old and the oldest manufacturer of street cars, is ill with the grip, at his home in New Rochelle.

At the offices of the Phonograph Company, in the Mills Building, there have been received phonograph cylinders carrying messages from Cardinal Manning to Cardinal Gibbons and Thomas A. Edison.

The New York hospitals have been receiving ambulance calls over the fire alarm telegraph circuits. No charge has been made for this service. Now that the wires have been ordered underground, the fire department does not feel able to stand the expense of putting in subsidiary connections for the hospitals. The hospital authorities do not want to pay the bill, either. One hospital has been cut off from the fire alarm wires.

Strenuous objections are being made by the residents of Brooklyn against the introduction of the trolley system. The fight is a bitter one, but unwarrantably so. May the trolley win at the final hearing before the State railroad commissioners, June 6.

A firm of Boston brokers in a recent circular state that the market value of electrical securities dealt in in Boston is over $60,000,000 and that Boston is the principal city in promoting these securities.

The recent Westinghouse stockholders' meeting in Pittsburgh lasted just eight minutes when the request to adjourn was received from the directors.

Col. John Jay Dickey, a prominent official of the Western Union Telegraph Company and well known among electrical people here in the East, received a highly complimentary, but brief biography from the Omaha *World-Herald* in a recent issue of that paper.

Mr. C. C. Curtis, the well-known wide-awake representative of the Brush Electric Company, was a New York visitor last week and called on his friends of the Electrical Review. Mr. Curtis is quite enthusiastic over the pronounced merits of the new Short gearless motor for electric railway work.

The Westinghouse Electric and Manufacturing Company.

A circular was sent out last Saturday afternoon to the stockholders of the Westinghouse Electric and Manufacturing Company, giving the details of the proposed reorganization of the company. It was found necessary, some time ago, to adopt some plan whereby the company might be kept out of the hands of a receiver, and the following scheme has been suggested by the officers of the company:

First—The present authorized capital stock of the company ($10,000,000) not to be increased.

Second—The present holders of the outstanding common stock of this company to assent to this plan, and to transfer and surrender to this company, or its order, to be used for the purposes hereinafter specified, 40 per cent. of the par value thereof (aggregating about $2,720,000), which, with the treasury stock now unsold, would make an aggregate of about $5,920,000 of unsold treasury stock.

Third—The 60 per cent. of stock retained by the assenting stockholders, together with the 40 per cent. surrendered, to be stamped "assenting stock" and to be entitled to a preference over the "non-assenting" stock in that no dividend shall be paid upon the "non-assenting" stock in any one year until after seven per cent. dividends shall have been declared and paid in that year upon the "assenting stock."

Fourth—$1,000,000 par value of the common stock so surrendered to be converted into preferred stock, which with the $3,000,000 of preferred stock now authorized, but unissued, shall constitute an authorized issue of $4,000,000 of preferred stock entitled to a seven per cent. annual preferential cumulative dividend, and also to a *pro rata* share of dividends declared in any one year after seven per cent. dividends shall have been paid in that year upon the other stocks outstanding, the entire $4,000,000 of preferred stock to have a preference in the assets of the company, but no part of the issue to have a preference over any other part thereof either as to dividends or assets. The remaining stock surrendered, amounting to about $1,920,000, to remain common "assenting stock."

Fifth—The said treasury stock, both preferred and "common assenting stock," to be used for the following purposes, viz: (a) $3,000,000 par value of the preferred stock to be issued for money and in payment of the company's debts. (b) $500,000 par value of the preferred stock to be left in the treasury of the company to provide further working capital when needed, and to meet other requirements of the company. (c) So much as is necessary of the remaining treasury stock to be used in the purchase of as many shares of the capital stocks, respectively, of the United States Electric Lighting Company and the Consolidated Electric Light Company, as the reorganization committee hereinafter named deem advisable. (d) The remainder of the treasury stock not used for the above purposes to remain in the treasury of the company for future use.

Sixth—This plan to be executed and carried out through a reorganization committee composed of Messrs. August Belmont, of August Belmont & Co., bankers, of New York; Mr. Charles Fairchild, of Lee, Higginson & Co., bankers of Boston, and Mr. Brayton Ives, president of the Western National Bank, New York, who shall have power to add not to exceed two members to and fill vacancies in their own number.

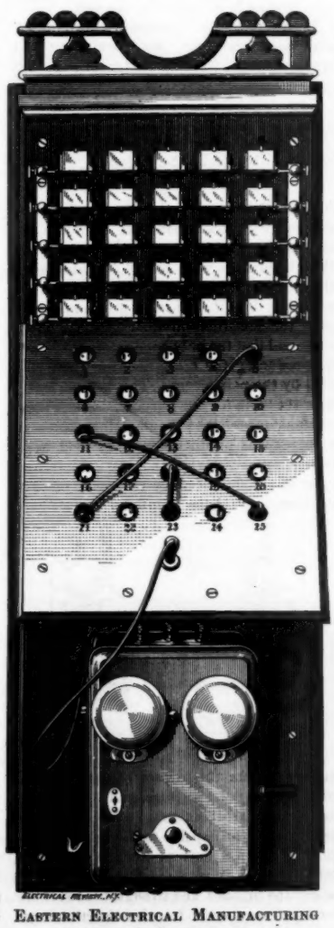
Seventh—The reorganization committee to be entitled to a substantial representation in the management of the company.

The reorganization syndicate, certain creditors and others, have agreed to take at par $3,000,000 of preferred stock, on condition that the stockholders return to the company 40 per cent. of their holdings as provided in the plan. It is stated that the majority of the large stockholders of the company had already assented to the proposed arrangement, so far as surrendering 40 per cent. of their holdings to the company is concerned.

The following gentlemen who have not been identified hitherto with the management of the company, have consented to become members of the board of directors in case the proposed reorganization is successful: August Belmont, Marcellus Hartley, Henry B. Hyde and Brayton Ives, of New York; and Charles Francis Adams and Charles Fairchild, of Boston.

A New Telephone Switchboard.

Telephone companies of the present and those now forming for the future will be interested in the announcement that the Eastern Electrical Manufacturing Company,



Eastern Electrical Manufacturing Company's Switchboard.

of Tonawanda, N. Y., with P. W. Scribner as president; James S. Thompson, vice-president; James H. Rand, treasurer; Walter Smith, secretary, and Claude C. Gould as general superintendent, is in the market with telephone appliances, which are being manufactured under United States patents, controlled by this company, as follows:

346,038,	January	11, 1887.	392,326,	Nov.	6, 1888.
356,403,	"	18, "	409,574,	August	20, 1889.
355,928,	"	11, "	422,765,	March	4, 1890.
355,929,	"	11, "	447,426,	"	3, 1891.
362,376,	May	3, "	Other patents pending.		

The advantages claimed by the company for their switchboards are those of good workmanship, low price, ease of manipulation and compactness. No spring jacks or sockets are used, connections being made through each subscriber's plug interlocking, which makes good rubbing contact. The illustration on this page shows a 25 wire board, including a magneto bell with talking and ringing circuits and a novel system of weights. This switchboard is 22 inches high, 8 inches wide, 4 inches deep, and is constructed so as to be secured to a wall. A transmitter is preferably placed at the top of the cabinet. The system can be manufactured up to a capacity of 1,000 wires.

The method of operation of this system is as follows: Subscriber No. 21 has signalled C. O. in the usual manner, the operator to answer takes operator's test plug, which is connected with the talking circuit, inserts it into No. 21 plug and raises both out of 21's holder and off of 21's ground and asks what number is desired. The operator is informed 21 wants No. 5. Operator separates test plug from No. 21, keeping 21 in one hand and with the other hand inserts test plug into No. 5's plug, depressing both until they are locked in No. 5's seat on holder. This movement shunts No. 5's annunciator. The operator depresses individual switch lever which cuts out talking circuit and cuts in generator circuit. This signals subscriber No. 5. The operator now raises the individual switch lever, which cuts in talking circuit as in its first position and informs No. 5 that No. 21 wishes to converse with him. Operator now separates test plug from No. 5's plug, inserts 21 into 5 plug, depressing both until they are locked. Operator replaces 21's fallen apron. This completes the movements in making the connection.

The circuit now is subscriber No. 21's ground through his telephone transmitter line wire and his annunciator, which acts as a clearing off drop, his cord and plug is 5's plug cord and line wire through No. 5's telephone and transmitter to No. 5's ground. To disconnect, subscribers have signalled C. O. that they are through in the usual manner. Annunciator No. 21, being in circuit, it is readily seen that the apron of No. 21 will consequently fall. Operator unlocks both plugs, releases plug No. 21 from plug No. 5 on the upward movement, lets 21 plug fall, and as the weight controls the cord and plug now it returns to its ground in 21's seat or holder. The operator now replaces the fallen apron (No. 21), thus completing the movements in making the disconnection between the two subscribers, 21 and 5. To every subscriber who calls C. O. and is connected through the switch, the calling subscriber's annunciator acts as a clearing off drop.

The Wightmdn Electric Manufacturing Company, of Scranton, Pa., are working day and night to fill the order for twenty motors for the People's Street Railway Company of Scranton. All the machinists who were employed at the People's Company's burned barn have been pressed into service, as well as all others who could be secured.

THE PROPHET'S COLUMN.

The recent blowing up of a Chilian warship by a torpedo is a hint of the part which electricity is destined to play in war. Napoleon said that Providence is always on the side of the heaviest artillery. Providence hereafter will be found on the side of the greatest electricians. Although so much has been written about electricity in warfare, its applications are so numerous and wonderful that some of them have not yet even been thought of. At present electricity is used for firing and manipulating guns, discharging and propelling torpedoes, for signaling, lighting and other minor uses. But by the use of electricity there is a possibility that gunpowder may be dispensed with. Imagine a modern battleship armed with great breech-loading rifles and immense dynamos. Instead of a cartridge containing gunpowder, there would be one partially filled with water in which there are two metal conductors connecting with the dynamo. Now, to fire the gun it is only necessary to turn on the current and decompose the water, thus producing an explosive mixture of hydrogen and oxygen which is ignited by an electric spark causing a violent explosion behind the projectile. To be sure, with our present knowledge there would be great danger of exploding the gun, because the gases would be present in exactly the right proportions (H^2O) to combine, and the mixture would not be "slow burning."

The idea of using bilge water instead of gunpowder seems at first preposterous, but there is nothing inherently impossible in getting a slow burning mixture of gases.

The plan of producing an explosive by electrolysis may have some application to small arms, and may be useful in blasting and in torpedo work.

This idea has also several useful possibilities in peace as well as war. In none of the schemes thus far proposed for heating by electricity has there been anything which even approximates an open fire of wood or coal. But a pan of water through which an electric current is flowing could be made to give off enough gas to keep up quite a respectable blaze. In the hands of an ingenious inventor the electric fireplace should soon become a reality.

Among the minor uses of electricity nothing is more interesting than its application to cooking. Members of the Electric Club have already had their steaks cooked on an electric broiler, and eggs boiled in water heated by electricity will soon be an old story. Here is a good chance for an inventor to devise a cheap electric heater which will replace the ordinary ones burning gas or alcohol, which are so common in hotels and restaurants.

Franklin is credited with the statement that the flesh of a goose killed by an electric current is particularly fine eating. This brings up interesting possibilities in the culinary art, and shows the far-reaching nature of the electrician's science. An electric current will replace the boarding house axe and tough steaks will become a thing of the past.

It is well known that milk sours during a thunder storm. Probably having this in mind a gentleman farmer, who is also somewhat of an electrician, is considering the possibility of producing butter by the direct action of the electric current on milk. Just how this is to be accomplished is not clear, but it is hard to say that electric butter will not be one of the products of the twentieth century.

Another inventor proposes to aereate waters by passing an electric current through them. There is no doubt that this can be done, but a stomach-full of such a mixture is too suggestive of dynamite to permit of its general adoption as a beverage. Already a number of plans have been proposed for ageing liquors and some have been tried with more or less success. Here is a pointer for the champagne makers.

THE PROPHET.

Notes on the Design of Multipolar Dynamos.

ABSTRACT OF A PAPER READ BY W. B. ESSON, BEFORE THE BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.

PREVENTION OF SPARKING IN MACHINES GENERALLY.

In the paper which I submitted for your consideration 12 months ago, attention was directed to certain empirical formulæ relating to the armature loads for direct-current machines. An expression for the load which could be safely carried by armatures without causing sparking was obtained. In that paper the term "ampere-

FIG. 1.

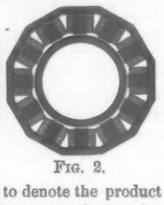


FIG. 2.

turns" was employed to denote the product of the number of conductors on the exterior of the armature and the current carried by each, and I am afraid this may have led to some confusion. In order that there shall be no misunderstanding in the present case, I shall call this product, quite irrespectively of the number of poles, the *volume* of current carried. The volume is, therefore, the total current flowing parallel to the armature shaft, independently of direction and whatever the number of poles, and it is obtained by multiplying the conductors on the exterior of the armature by the current flowing in each; or, considering the exterior winding as a copper cylinder, it is the total current flowing in it parallel to the axis.

In his paper on "Armature Reactions," read here last year, Mr. Swinburne had worked out the limiting load from a theoret-

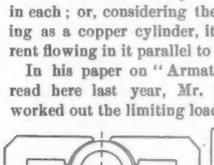


FIG. 3.

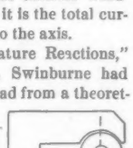


FIG. 4.

ical point of view, and those who were present will remember that to obtain the results given in his paper the author assumed that the brushes were placed almost close to the polar tips. For the moment, it will be assumed that the brushes are somewhere near the pole-tips—in their vicinity, let us say—and that the only conductors concerned in producing the cross field are those covered by the pole-pieces. This is sufficiently near the truth for our purpose. Under these circumstances the magnetizing force in ampere-turns producing a cross field is, of course, $\pi\,\phi \div 360$ where v is the volume, and ϕ the angle embraced by each pole-piece in degrees. Call l the length of the air gap,

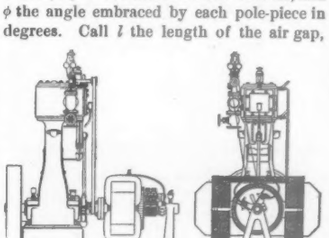


FIG. 5.

measured from the surface of the armature core to the polar surface, and I the induction per square centimetre which would be produced in the gap due to the field magnets alone. When a current flows in the armature the field is weakened at the pole tips nearer the brushes, and strengthened at those farther from them. Imagine that the armature is loaded so that the forward induction under the nearer pole-tips is just balanced by the cross induction, and we have $v\,\phi \div 360 = 2\,l \times .8\,I$, assuming that the components of the cross circuit, other than the air gap, have no resistance. According to this equation, with a value $v = 576\,l\,I \div \phi$, the forward and cross induction at the pole-tips would be equal, the field would be *nil* at the brushes, and the machine being unstable, any increase of current would at once cause great sparking. The above expression gives what might be called the theoretical load limit. In the nature of things, there is in the dynamos of different makers a considerable variation in the relation which actual load bears to this limit. This large margin must be considered in the light of a safety factor, for it would be folly to build machines the commutators of which would be liable to ruin by an occasional increase of current over the normal. No one expects machines to stand, in continuous working, a current of 50 per cent. over their normal output, for the rise in temperature would

FIG. 6.

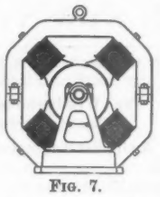


FIG. 7.

then be excessive; but, from the sparking point of view, this increase in a well-designed machine ought to make but little difference to it. Generally, the relation existing between the volume, gap dimensions, and induction in the best machines is expressed approximately by the equation, $v = 288\,l\,I \div \phi$, which gives, I consider, a very good rule for use in practical work.

It is easy to translate the above expression into the form I previously used for cylinder armatures. Call r the radial depth of the armature core, w the width of the pole-piece, we get for bi-polar Gramme-wound machines the expression $v = r\,l\,85000 \div w$.

THE RELATION OF v TO THE DIAMETER OF THE ARMATURE.

But besides taking care that the armature load does not approach the sparking limit,

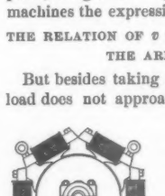


FIG. 8.

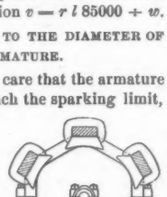


FIG. 9.

we must provide ample surface for getting rid of the heat generated in the conductors. The first thing to be settled in designing a new machine is what this amount of heat shall be; or, in other words, we must fix the ratio which the energy appearing at the terminals shall bear to the total electrical energy produced. Having settled this, sufficient radiating surface must be allowed to prevent too great a rise in temperature—a point to which due consideration has already been given.

The principal factors which determine the relation of the volume to the diameter of the armature are efficiency and temperature.

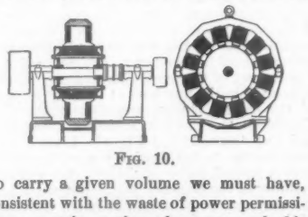


FIG. 10.

To carry a given volume we must have, consistent with the waste of power permissible, a certain section of copper; and this copper should be disposed so that a cooling surface is provided sufficient to keep the rise in temperature within the specified limit, while the gap, being of sufficient length to prevent sparking, should have only the dimensions necessary for accommodating the conductors and allowing of proper clearance.

Though the relation lacks definiteness to some extent, I find in the data of a large number of machines indications sufficiently pronounced to justify us in regarding the volume carried by the armatures of two-pole dynamos as proportional to the diameter for all sizes. In designing cylinder machines, the value of v may be taken as 400 times the diameter of the armature in centimetres, while for drum armatures the volume is obtained by multiplying the diameter by 600. The cylinder armature has for a given volume a larger diameter, because of the influence of the interior wires. These being heaped inside to one and a half or twice the depth of the exterior winding, also being longer, a larger diameter is required for a given volume, both from efficiency and temperature considerations. Necessarily, the relations here given are not of a hard-and-fast character, and may be varied considerably. But whatever the proportion adopted, it is absolutely essential that the sparking limit already considered be not too closely approached.

In machines having four and six poles, the same average relation between the volume and diameter holds in practice for both cylinders and drums.

OUTPUT OF DIRECT-CURRENT ARMATURES.

If we call N the total number of lines of force entering the armature from all the poles, however many, and n the number of revolutions per second, the average E.M.F. generated in each conductor is, of course, $N\,n\,10^{-8}$. If C be the total current flowing, each conductor will carry with the sections coupled in the ordinary way $C \div p$ amperes, p being the number of poles. The electrical work due to each conductor is $C \div p \times N\,n\,10^{-8}$; and the total work $w\,C \div p \times N\,n \div 10^{-8}$ where w is the number of conductors, counted all round the extent of the armature. The quantity $w\,C \div p$ is what we have called the *volume*, and we got for the total electrical output in watts the expression $w = N\,n\,v\,10^{-8}$, which is quite independent of the manner of coupling up the armature sections. It will be evident, I think, that with the same relation existing between v and d for two, four, and six poles, the output of an armature of given diameter and length, running at the same speed, is quite independent of the number of poles. It matters not whether N be furnished by two poles only, or by four poles of half the angular width, provided its value remains unaltered.

The volume, then, may be expressed in terms of the diameter. The quantity N may be expressed in terms of the diameter $\times$ length of the armature. Taking an induction of 5,000 C.G.S. units per square centimetre in the air gap—a very usual figure—and assuming that the fraction of the armature circumference covered by the pole-pieces $= 2.25\,d$, we get, calling L the length of the armature in centimetres, $11{,}250\,d\,L$ as the total number of lines of force entering the core. Call this, in round numbers, $12{,}000\,d\,L$. Substituting for N and v their values, the output becomes for cylinder armatures $w = .048\,d^2\,L\,n$; and for drum armatures $w = .072\,d^2\,L\,n$. This applies to all direct-current machines, whether bi-polar or multipolar; though it will be understood, of course, that the induction in the gap may be greater or less than what has been assumed. In that case the coefficients .048 and .072 would be altered, without changing, however, the form of the expression.

OUTPUT OF ALTERNATING CURRENT ARMATURES.

The armature loads for alternators, though producing a cross magnetization, as in direct current machines, raise no considerations, of course, as regards sparking. But on account of the greater proximity of the poles, and the greater stray field resulting, it is desirable to make the layer of copper on the armature core as thin, and the air gaps as short as possible. As a consequence, probably of the increased ratio of stray to useful field, the induction is less in the gaps of alternating than in those of direct current machines. The two types are quite unlike in their proportions, as Figs. 1 and 2 show, and no one would think of making them the same. Fig. 1 represents the magnetic system of a four pole direct, and Fig. 2 that of a 12 pole alternating machine of the same output; and while it will be observed that the iron parts—core and yoke-rings—are much heavier in the former, it will be no-

ticed that the copper in the magnet coils is much heavier in the latter. In fact, though the iron in the alternator is only 55 per cent. of that in the direct-current machine, the copper required is no less than 250 per cent. It is difficult, then, to understand what useful purpose is served by comparisons such as I have alluded to.

RELATION OF AIR GAP TO DIAMETER OF ARMATURE AND NUMBER OF POLES IN DIRECT-CURRENT MACHINES.

Having established the proportionality of the volume and diameter, it is easy to find the relation which must exist between the diameter and length of air gap for any particular angle of embrace in order that sparking may not occur. But, as is also seen from the equation, the gap required for any particular volume is proportional to the angle of embrace, and if we substitute for two poles a greater number, of correspondingly less angular width, working with an increased diameter and volume without a proportionally increased gap is made possible. This is where the advantage of the four, six or even eight pole machine comes in. Keeping to two poles, increasing the diameter requires either a proportional increase in the gap, whether the space is required for the conductors and clearance or not, or an increased induction, or a diminished polar angle, or a combination of these. The work done by an armature of given external dimensions we have seen to be quite independent of the number of poles, and the choice of this number can only be a question, therefore, of structural and working economy.

DIMENSIONS OF THE ARMATURE.

It has been observed that the output of an armature is proportional to $d^2 L$; and the induction being the same, the weight of the core for a given number of poles must be proportional to the output, the radial depth increasing directly as the diameter, so that a proportionally increased field may be carried. The number of poles being fixed, the weight of the core for a given output may be taken, therefore, as approximately constant, whatever the ratio of L to d.

The power wasted in hysteresis is proportional to the weight of iron magnetized, and to the number of reversals per second. The weight being inversely, and the reversals directly, as the number of poles, the power wasted is for a given output the same.

So much for the core; let us now consider the copper part. Taking Gramme-wound armatures having an interior opening equal to .66, or two-thirds of the core diameter, it is found—the output, speed and temperature being predetermined—that the ratio of L to d may vary through a considerable range without making any great difference in the weight of copper or efficiency.

All the above facts go to prove that if there is anything to be gained, as regards the production of the field, by increasing the diameter of the armature and the number of poles, there is nothing, considering the armature by itself, to be lost by it. It may, in fact, be rather an advantage, because the weight of the iron core is reduced. It is true the peripheral velocity is increased, but this does not matter in the least, provided a certain limit is not exceeded. Opinions differ as to what the limit should be, some machines working at 50 feet per second, others at 100 feet, and a few as high as 125 feet.

DIMENSIONS OF THE FIELD MAGNETS.

It will be apparent, from the foregoing considerations, that the employment of two or more than two poles for direct-current machines of moderate dimensions resolves itself mainly into a deliberation regarding the most economical shape to give to the field magnets. As regards the armature, considered by itself, we may say that the choice of dimensions is mostly a matter of convenience, seeing that the amount of copper required and efficiency are for a given output practically unaltered by variations in this respect, while the reduction in the weight of the core, due to an increased number of poles, is to some extent compensated by the extra expense of larger plates and increased weight of the armature supports. Again, the cost of labor is increased by the larger diameter; but, everything being taken into account, considerations respecting the armature do not influence the design to a very great extent.

I have said that for the prevention of sparking it is necessary that, the induction per square centimetre remaining the same, the air gap increases proportionally to the diameter, whether the space is necessary for conductors and clearance or not, but that the coefficient by which the diameter has to be multiplied to give the length of the gap necessary to prevent sparking diminishes directly as the pole angle. In comparing the magnetic system of a four or six pole machine with that of a two pole one, it is necessary to adopt dimensions for the armature in accordance with the considerations already mentioned; hence, if the two pole armature had a length of core equal to one and a half times its diameter, in a four pole one the length should be about half the diameter. The diagrams (Figs. 3 and 4) show the cross-sections of two such machines. The diameter of the four pole armature is 1.4, and its length .5 times that of the two pole one, consequently both machines give the same output. The weight of the two horseshoe magnets in the four pole machine comes to 56 per cent. of the weight of the single horseshoe magnet, which indicates, in this particular case, a considerable saving in wrought iron.

When we come to machines of a certain size there is undoubtedly a gain in employing more than two poles, while very large machines become impossible of construction with two poles only. But to go beyond four poles in many cases would be a mistake. Increasing the poles always results in an actual increase of copper, unless at the same time the power spent in the gap is reduced, and this latter must be effected without reducing the thickness of the armature winding.

Having discussed the design of multipolar machines as influenced by both theory and practice, it remains to conclude this communication by calling attention to some of the ordinary forms of multipolar fields. The double wrought iron horseshoe (Fig. 4) is not very frequently used, being rather costly; but a similar machine with magnets of cast iron, lately made by my firm for the National Line steamship "America," is shown in Fig. 6. This design, introduced by Gramme in 1869, generally gives place to the arrangement shown in Fig. 5, a form designed by the same inventor in 1885, and since adopted for cylinder-wound armatures by many makers, including Mr. Jaspar, in Belgium; Mr. Brown, of the Oërlikon Works, in Switzerland; and Messrs. Patterson & Cooper, in England. Fig. 7 represents a similar field in which the magnet cores are of wrought iron, fitted with cast iron pole-pieces, as used by Mr. Kapp. The decision as to whether cast iron or wrought iron should be used is arrived at in a very simple manner—by comparing the excess of copper required on one hand with the extra machining required on the other.

All these are examples of single magnetic circuits, where the lines of force from each pole remain undivided in their paths through the magnetizing coils; but in Figs. 8 and 9 are shown examples of double magnetic circuits, in which the lines from each pole take two paths through separate coils. Fig. 8 is a type of magnet used by Sautter-Lemmonier, of Paris, for Gramme-wound armatures, and by Cuenod-Sautter, of Geneva, for armatures having a Siemens winding as modified by Thury. It looks at first sight as if the weight of copper were not very different in the two types, but in this respect appearances are deceptive, for, as a matter of fact, the field of a four pole machine made to Fig. 8 would require about 125 per cent. more copper than if made according to Fig. 7. It will be observed, however, that the magnet cores and pole-pieces, which are made throughout of the softest wrought iron, are very light. In Fig. 9 the magnets are a series of wrought iron bars lying parallel to the armature, each fitted with a cast pole-piece in the middle of its length, and having two magnetizing coils, one on each side of this piece. It is a structure which may be frequently met with, though not precisely in the form shown, and the observations regarding the copper made with reference to Fig. 8 apply equally here.

The fields of alternators may be similarly divided into those having single and those having double magnetic circuits; the former requiring, as in the fields of direct-current machines, much less copper than the latter. Amongst those having single magnetic circuits are the machines of Siemens, Ferranti, Mordey, Westinghouse, Elwell-Parker and Paterson & Cooper. Mr. Kapp possesses the distinction of having the only alternator with double magnetic circuits. The "Phœnix" alternator, shown in Figs. 10 and 11, possesses some features which may be of interest as illustrating the way in which the commercial aspect of designing has to be considered.

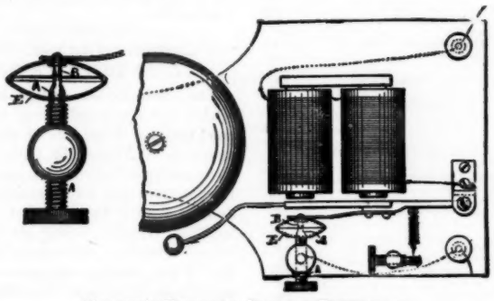
Varley's Electric Contact Protector.

Much difficulty is frequently experienced in the electrical operation of call bells in consequence of particles of dust or other foreign substances getting in between the contact points, and the risk of the alarm becoming inoperative is augmented by the fact that considerable periods of time often elapse during which the call is not in use.

To obviate this, Mr. Richard Varley, Jr., of Englewood, N. J., electrician at the works of the Okonite Company, has invented the device shown in the accompanying illustrations. As will be seen, the contact A is in the form of a screw with a platinum plug, and the other contact, B, is held by the spring attached to the armature.

The protector E is made of thin sheet rubber that extends from one contact to the other, forming a dust-proof inclosure. The protector is made of two disks, with a central opening in each, one fitting around the button head of the contact B, and the other around the end of the screw A. The disks are united at their edges and vulcanized, thus excluding all dust. Hence, it is not necessary to enclose the bell or magnet in a case, as is sometimes done, to aid in keeping the bell in working order.

The protector can be similarly made for the contacts of a telegraph key, the contact studs having heads with annular channels or necks for the edges of the elastic disks.



VARLEY'S ELECTRIC CONTACT PROTECTOR.

LITERARY.

"Bulletin de la Société Internationale des Electriciens," for April, 1891, has been received.

"Third Annual Report of the Hebrew Technical Institute," of New York, has been received. The showing made is a creditable one.

"Cornell University—Her General and Technical Courses," is a handsomely illustrated souvenir book, by Frank C. Perkins, an electrical engineer of Dunkirk, N. Y.

With every issue the *New England Magazine* becomes wider in its scope, and is more artistically gotten up, it being the evident desire of the editors and publishers to make it take first rank among the great illustrated monthlies. The May number presents a varied and excellent table of contents.

St. Nicholas for May presents a very tempting table of contents, beginning with an imaginative poem, "Morning," by the late Emily Dickinson, whose work has been so cordially praised by the critics. Nora Perry's "Siege of Calais," a ballad with striking illustrations by Birch, will delight little students of history, who will also read the second paper on "The Land of Pluck," by Mrs. Dodge, with keen delight, supplemented, as it is, by two very interesting letters on Holland, in the letter box department.

The May *Century* begins a new volume, and in it are begun several new features of what the *Century* calls its "Summer Campaign." "The Squirrel Inn," by Frank R. Stockton, is one of the principal and most popular of these new features. The "Inn" itself is carefully depicted in a picture which is the joint product of the artistic skill and ingenuity of both the author and Mr. Frost, the illustrator. Mr. Frost brings out also several of the principal characters of the story—which promises to be one of the most curious and characteristic of Mr. Stockton's inventions.

Yankton, S. D.—Yankton Gas and Electric Light Company; capital, $200,000. Incorporators, T. W. Pratt, W. I. Wellman, J. H. C. Young, Hughes East, Tams Bixby, R. C. Elliott.

Chicago, Ill.—Independent Lighting and Supply Company; capital, $60,000; for lighting cities with electricity, gas and oil. Incorporators, G. P. Markham, B. A. May, E. Y. Loomis.

Covington, Ky.—Creaghead Engineering Company, incorporated to manufacture all kinds of electric, mechanical and manufacturing appliances; capital, $25,000. Incorporators, H. D. Emerson, T. J. Creaghead, C. L. McCrea and others.

Carbondale, Ill.—Carbondale Electric Company; to construct and operate an electric light plant; capital, $5,000. Incorporators, Rufus D. Bradberry, George W. Graham and W. A. Schwartz.

Waynesboro, Pa.—Waynesboro Electric Light and Power Company; capital, $15,000. Directors, E. Elder, Daniel Hoover, J. H. Crebs, D. H. Geiser, W. H. Brown, F. Forthman, J. F. Zullinger, Waynesboro. Treasurer, W. T. Omwake, Waynesboro.

Chicago, Ill.—The People's Electric Light, Power and Heat and Street Railroad Company; capital, $80,000; to operate street railways by electricity in Cook and Du Page Counties and to furnish light, power and heat, and to manufacture electrical appliances. Incorporators, C. L. Sackett, J. S. Ranney and G. K. Jones.

Topeka, Kan.—The Quivera Dam and Electric Power Company, for the construction of a dam across the Kansas River at Morris Station, on the Santa Fe Railway, near Kansas City; capital, $500,000. Directors, A. S. Johnson, A. S. Mulvane, Joab Mulvane, C. K. Holiday, George E. Wilder, of Topeka; E. B. Purcell, of Manhattan, E. W. Armour and Howard Holden, of Kansas City.

Auburn, Me.—A record of the formation of the Southern Maine Telegraph and Telephone Company has been made recently at the registry of deeds office in Auburn. The counties in which the company is to operate are Androscoggin, Cumberland and York. The capital is $50,000 and the par value of each share is $10. F. W. Dana has 41 shares, as has Warren Riker, F. L. Hoyt, William Dickey, J. N. Wood, Charles Gay and W. H. Miles. E. W. Gross has 82 shares. Frank W. Dana is president of the company and Warren Riker is treasurer. The directors are Messrs. Dana, Dickey, Hoyt, Gross and Miles.

Electricity in Dentistry.

Some of our foreign contemporaries are just learning that electricity has been found useful in extracting teeth. The plan pursued is to give the patient an electric shock at the moment the tooth is pulled. This is a very old idea. A patent was granted to W. G. Oliver, in 1859, for producing local anæsthesia in any part of the body upon which a surgical operation was to be performed by passing a current from an induction coil through the part. Several patents were granted about the same time to Dr. Francis, of Philadelphia, and others, involving a similar application during a dental operation. Of late years, Dr. Eisenhart, of York, Pa., and Smith and Kimble, of Peoria, Ill., have revived the subject. Dr. Eisenhart's method is to pass the current through the arms and body of the patient during extraction; the effects of the current are not particularly disagreeable. From the testimony of a large number of patients, it appears that there is insensibility to the pain usually present in extraction.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 3329. NEW YORK.

EDITOR:
CHAS. W. PRICE.

ASSOCIATE EDITORS:
STEPHEN L. COLES. ROBT. H. READ.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.
"1546 CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
W. I. BARKER, Room 29, 620 Atlantic Ave.
WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.
CHICAGO OFFICE:
L. W. COLLINS, 435 "The Rookery."
EUROPEAN OFFICE:
CHARLES FFRENCH, Editor for Europe.
HOTEL VICTORIA,
Northumberland Ave., Charing Cross, London, W. C.
Cable Address: - - "Electview," London.
Telegraphic Address: Ffrench, "Victoriola," London.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

PATENT BUREAU,
ROBT. H. READ, Manager.
Patents procured in United States and all foreign countries. Searches, Investigations and Reports on Validity and Infringement.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.
One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 6.00
Single Copy, - - - - .10

ANNOUNCEMENT.
Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, MAY 16, 1891.

CONTENTS.

	PAGE.
Views, News and Interviews	157
The Westinghouse Electric and Manufacturing Company	157
A New Telephone Switchboard	157
The Prophet's Column	158
Notes on the Design of Multipolar Dynamos	158
Varley's Electric Contact Protector	159
Literary	159
New Corporations	159
Electricity in Dentistry	159
Telephone Transmitter for Long Distance Work	160
The Savage and the Circuit	160
Correspondence:	
Our London Letter	161
Our Chicago Letter	161
Our Cincinnati Letter	161
Air Navigation	161
Financial	161
Telephonic News	162
Armstrong's Trailer Connection	162
A New Bi-Metallic Conductor	162
Engineering Association of the South	162
Removal Notice	162
The Reflecting Galvanometer—Your Use of It and Its Abuse of You	163
An Improved Electric Light Signal	163
A New Iron Box Bell	163
Photoelectricity	163
Telegraphic	163
Annual Meeting of the New England Telegraph and Telephone Company	163
Electric Power	164
Model Motive Power	164
The Cobb Wire Company in Trouble	164
Electric Clubs:	
New York Electric Club	164
Buffalo Electrical Society	164
The Franklin Club, of Newark	164
American Institute of Electrical Engineers	164
Eastern Electric Door Pull	164
The Norwalk Electric Light Station	164
Paper Insulation for Telephone and Telegraph Cables	165
The Meeting of the Westinghouse Company	165
Electric Light News	165
An Interstate Association	165
Stanley's Alternating Current Fan Motor	166
Lightning Rods	166
The North Western Thomson-Houston Company	166
Magnetic Shunts	166
Increased Factory Facilities of the Schuyler Electric Company	166
Patent Rights of Employer and Employé	167
Personal	167
A New Form of Standard Cell	167
Kindred Interests	168
The Properties of Aluminium	168
Electrical Patents	168

INDEX OF ADVERTISERS.

COVER PAGES.	PAGE.
Alexander, Barney & Chapin	xxiii
Ansonia Brass & Copper Co	xxiv
Armington & Sims	xxiv
Baker & Co	xxiii
Bridgeport Brass Co.	xxiv
Day's Kerite Insulated Wires	xxiv
Eastern Electric Cable Co.	xxiv
Hampson & Co., E. P.	xxiv
Jewell Belting Co.	xxiv
Keasbey, Robert A	xxiv
Moore, Alfred F	xxiv
Okonite Co	xxiv
Otis Bros. & Co	xxiii
Schuyler Electric Co	xxiii
Standard Underground Cable Co	xxiv
Tucker Electrical Construction Co	xxiv

INSIDE PAGES.

Accumulator Co	xxii
American Bell Telephone Co	xv
American Electrical Works	xiii
American Electric Elevator Co	vii
Ball Engine Co	vi
Ball & Wood Co	vi
Barnes Co., W. F. & John	vi
Barr Electric Manufacturing Co	xii
Baxter, H. E. & C	xvii
Berlin Iron Bridge Co	vii
Bernstein Electric Co	iv
Bishop Gutta Percha Co	iii
Brownlee & Co	xii
Brush Electric Co	xvi
Buckeye Engine Co	vi
Burton Electric Co	xxi
Carhart & Co., E. M	vii
Cary, Alanson	ix
"C. & C." Electric Motor Co	xv
Central Electric Co	iv
Century Dictionary	xi
Cralle & Co., J. B	xii
Crocker-Wheeler Motor Co	xii
Crosby Electric Co	vii
Dixon Crucible Co	xvii
Douty, W. H	xiv
Dwight Slate Machine Co	xii
Eastern Electrical Manufacturing Co	iii
Eastern Electrical Supply & Construction Co	xix
Edison General Electric Co	xx
Electrical Supply Co	vii
Electric Construction & Supply Co	xi & xiv
Electric Merchandise Co	vi
Electric Secret Service Co	xiv
Elektron Manufacturing Co	xxi
Empire China Works	xxi
Empire City Electric Co	xv
Equitable Engineering and Construction Co.	xvii
Eureka Electric Co	vii
Eureka Tempered Copper Co	viii
Evans Friction Cone Co	xv
Faraday Carbon Co	xi
Fletcher & Fletcher Electric Co	xvii
Foote Regulator Co	iv
Fort Wayne Electric Co	xxii
Garvin Machine Co	vi
Globe Co	xii
Gordon & Co., W. H	xv
Greeley & Co., The E. S	xvii & xxi
Hay Manufacturing Co., Walter	168
Heine Safety Boiler Co	vi
Holmes, Booth & Haydens	iv
Hunt Engineering Co	xii
Independent Bung Co	iv
Interior Conduit and Insulation Co	viii
Kulp, D. H	xvii
Laird & Lee	xiii
Lane & Bodley Co	xvii
Law Telephone Co	168
Leclanche Battery Co	xiii
Lehigh Valley Creosoting Co	viii
Marshall, Wm	xvii
Milliken Bros	viii
Mosher Arc Lamp Co	viii
National Carbon Co	iv
National Electrical Manufacturing Co	xxii
National Pipe Bending Co	xix
New England Butt Co	vii
New York Belting and Packing Co	xxi
New York & Ohio Co	viii
New York Safety Steam Power Co	vi
Noye Mfg. Co., John T	vi
Ostrander & Co., W. R	xvii
Paiste, H. T	xii
Parker-Russell Mining and Manufacturing Co	xxi
Phœnix Glass Co	xiii
Phosphor-Bronze Smelting Co., Ltd	xv
Pond Engineering Co	vi
Pray, Jr., Thos	xiii
Prentiss Tool and Supply Co	168
Reddaway & Co., F	ix
Ridlon & Co	168
Royce & Marsan	xii
Sawyer-Man Electric Co	ix
Schieren & Co., Chas. A	168
Schwarzwaelder & Co	ix
Sessions Foundry Co	ix
Shultz Belting Co	viii
Sigourney Tool Co	xvii
Simplex Electrical Co	xiii
Standard Electric Supply Co	xxii
Standard Paint Co	xiii
Stanley & Hall	vii & x
Stephenson Co., John	xix
Thomson-Houston Electric Co	v
Tropical American Telephone Co	iii
Universal Arc Lamp Co	xii
Washburn & Moen Manufacturing Co	iii
Watson & Stillman	viii
Western Electric Co	xxi
Westinghouse Electric and Mfg. Co	xvii
White Dental Manufacturing Co., The S. S	iv
Williams & Potter	ix
Wyckoff, Seamans & Benedict	168

The reorganization of the Westinghouse electric interests is practically assured. The adjourned meeting to be held on the 18th inst. will doubtless result in a confirmation of the plan of reorganization which we publish, with authority, in this issue. Mr. Westinghouse and the whole electrical field are to be congratulated upon the happy culmination of an affair which did indeed look dark for a time. The new company will be in a position to handle a greatly increased business, and to successfully compete with other large companies in the same business.

The manufacture of submarine cables has now, for the first time in the history of the industry, been established outside of England. The new cable factory of the Société Générale des Téléphones, at Calais, was inaugurated with much ceremony last month. The equipment of the factory is described as being of the most modern description and perfect in every detail. The monthly output of complete armored cable is estimated at 500 knots, and it is said that sufficient orders are on hand to last several years at this rate of production, which goes to show that the establishment of the factory is no very speculative enterprise. Perhaps some day we may have a submarine cable factory in the United States.

The directors of the World's Fair will make a grave and unpardonable mistake if they insist on splitting up the electrical exhibits, or on confining them to an inadequate space. Electrical men are prepared to make their part of the exhibition the grandest and most complete demonstration of the applications of electricity possible to imagine. If the directors persist in their narrow-minded policy of belittling the electrical exhibit, they will rob the Fair of what promises to be its brightest jewel.

The American Society of Civil Engineers will hold their annual convention at Lookout Mountain, near Chattanooga, beginning May 21. Among the papers to be presented on matters of interest to electricians will be one on the "Construction of the Chimney for the Narragansett Electric Lighting Co.," by John T. Henthorn, C. E. There will also be a discussion upon a paper by Lincoln Moss, published during the past year, on "Comparative Tests of an Electric Motor and a Steam Locomotive on the Manhattan Elevated Railway."

The electric railway is trying hard to obtain a footing in New York, and with good strategy is endeavoring to capture the outposts and outlying districts first. Brooklyn and the annexed district are striving hard to secure the advantages of electric traction. The opposition comes from the political press, ever on the lookout for electrical sensations, and from a timorous and ignorant section of the public, which evolves from its own inner consciousness the dangers that it fears. In spite of all opposition, however, electric traction will win the day; as to that we do not entertain the smallest particle of a misgiving.

TELEPHONE TRANSMITTERS FOR LONG DISTANCE WORK.

The London-Paris telephone line has settled down to steady work and is doing good business at the rate of about 50 messages a day. Already 15 Paris subscribers have arranged for direct connections with London from their own stations, and several London houses have applied for similar facilities. It was recently stated at a meeting of telephone subscribers, in London, that if the exchange subscribers could get direct connection with the Paris line the traffic would be greatly increased, and in support of this contention the speaker added that on one occasion during that very week he could have saved his firm several hundred pounds if he had been able to speak to Paris direct from his office. These results entirely support the views set forth in our recent editorial on the subject, in which we held that the commercial success of such lines is assured beforehand from the very nature of the case. The long distance telephone carries a class of traffic which the telegraph cannot handle; this traffic goes to the telephone and to the telephone only, and a telephone line between two important centers a long distance apart is bound to create in a very short space of time all the business it can handle. Numerous experiments have been made with the new line, such as speaking direct between London and Brussels, and London and Marseilles, both of which trials were perfectly successful. At present the English and French authorities cannot agree as to the form of transmitter to be permanently adopted. In London the Gower-Bell is in favor, in Paris that known as the Ader, both being modifications of the carbon rod form of transmitter. Numerous trials have been made and in order to do away with the difference found between the voices of the speakers, it is proposed in future experiments to use a phonograph, thus making the conditions exactly the same for both transmitters. It appears to us, however, that there will still remain the personal equation of the listeners, and, besides, a very slight difference in the speed of the phonograph would probably affect the results to a considerable extent. The best solution of the difficulty would be to procure a couple of American Bell long distance transmitters. This form of transmitter is unquestionably more efficient than the Gower-Bell instrument, and we have little doubt that its adoption on the London-Paris line would give complete satisfaction to all parties concerned.

THE SAVAGE AND THE CIRCUIT.

Of the many charges against Henry M. Stanley, made by his petty detractors, one is probably true, and that is the allegation that whenever he met a native chief, arrangements were made with a battery, so King Cuffee received a shock on shaking hands with Mr. Stanley, and was duly impressed with this evidence of the supernatural potency of the white man. It is beyond understanding why fault should be found with this harmless and efficient method of teaching a truth. The explorer received the identical physical effects which were imparted to the savage, the only difference being the mentality of the two races, the fact being that one was enabled by generations of civilization to ascribe the effects to material causes, while the other in his ignorance had nothing in his mental scope to apply a train of reasoning and, therefore, used the resource which ignorance always applies to the unknown, and supernaturalism was called in to fill the logical vacuum in the savage mind.

This action of Mr. Stanley was not without precedent in diplomatic dealings with savage tribes. After the conquest of Algeria by the French, the government employed Houdin, the juggler, to visit the tribes for the purpose of breaking down the influence of the native necromancers, whose efforts were antagonistic to the French. Houdin did not use those adroit feats which entertained the children from eight to 80 in Paris a generation ago, for the inference of the natives would be merely that the Frenchman was a great necromancer, and, therefore, he avoided for the most part, feats which showed his personal dexterity, but used apparatus charged with electricity, claiming that he could act upon their strength at will, giving them pain or making them weak, the latter being based on picking up pieces of iron which were armatures of electro-magnets which were concealed in the apparatus. The piece of metal would be taken up at random, and passed around and then Houdin would declare that he could make them so weak that none of them would have strength to pick it up. The endeavors to raise the piece of iron would be fruitless, and terminated by shocks from a frictional electric machine, which would strike terror into the soul of the native.

When the telegraph was first put across the Plains there were apprehensions that hostile, or at least meddlesome, Indians would cut the wires, but the parties engaged in laying the line used the facilities for giving the Indians such severe shocks that no trouble occurred from this source for a long time, until a young buck climbed a pole to cut the line with his tomahawk at the very instant that the wires were struck by lightning a number of miles away. His death under circumstances which would be tragic in any event, was doubly impressive to those Indians who were assembled, and the result secured immunity to the wires for a long time.

It is much better to use a savage to complete a circuit, than to make him serve as a target for projectiles, and the objection to this application of science for conquest is certainly more nice than wise.

C. J. H. WOODBURY.

The new music hall at Fifty-seventh street and Seventh avenue, New York, is a beautiful evidence of the triumph of electricity in the art of lighting. The hall was opened on May 5 by a music festival, in which a large number of distinguished vocalists participated, together with about 500 ladies and gentlemen of New York. The incandescent lamps are distributed in a tasteful arrangement around the ceiling and at the sides, and at the lower edges of the balconies and in the arches over the stage. Ground glass bulbs are used, and the effect is exceedingly soft. There is a beautiful radiance throughout the whole of the auditorium without the usual painful effect of a glaring front light upon the eyes. The system is admirably designed, and reflects great credit on Mr. Charles H. Davis, of New York city, who was the electrical engineer.

CORRESPONDENCE.

OUR LONDON LETTER.

RAPID TELEPHONING BETWEEN LONDON AND PARIS—SUCCESSFUL ELECTRIC OMNIBUS—TELEPHONES FOR IRELAND—BIG ELECTRIC LIGHTING BUSINESS.

The Paris-London Telephone.—While the London postal authorities look forward to a considerable development in its future use, they appear perfectly satisfied with the present initial working. Over 50 messages are daily transmitted, chiefly on commercial and stock exchange matters. I am informed that a press message of 300 words was transmitted accurately to Paris in three minutes by one correspondent, a great saving on telegraphing cost.

The City and South London Electric Railway.—On the opening day of Sunday traffic, at the beginning of the month, over 17,000 passengers were carried on this line.

Messrs. Woodhouse and Rawson United, Limited.—This firm have so many orders in hand for steam and electric launches, and there are so many more under negotiation, that they have decided to increase their riverside premises and have purchased two-and-a-half acres of ground close to Kew railway bridge on the Surrey side, and with a river frontage of nearly 700 feet. The new works are to be in working order in two months time and face the two existing yards; there will be good dock accommodation for launches, tugs or barges undergoing repairs or alterations.

Institution of Civil Engineers.—When Mr. Crompton read his paper last week there was a most interesting exhibition of machinery and apparatus. The new electric safety valve of Messrs. Hedges and Lowrie for high tension circuits was much noticed, as was, also, a complete set of concentric wires and fittings by Messrs. J. D. F. Andrews & Company, showing concentric armored mains with branches, brackets, pendants and standards fitted throughout with concentric switches and fuses. The wiring was most neat in appearance, and for flexibles, exterior braided copper is used, the inner conductor being a fine copper strand inside.

West End of London Electric Lighting.—It has been settled that electric light mains in Bond street are not to be put down until after the London season has closed.

The Naval Exhibition.—At the opening of this exhibition on May 2, by the Prince of Wales, an electric current will set free the national standard on the top of the model Eddystone Lighthouse and from which after dark an immense electric light will flash each night during the exhibition.

The Boy Messenger Company.—The dispute between the Postmaster-General and the above company has at last been satisfactorily arranged without a long legal action, by a license being given to the Boy Messenger Company under the government monopoly for the carrying of letters. The post office new express service will, however, do away with a good deal of the company's work.

Church Electric Lighting.—Messrs. Verity are now fitting up the Church of St. Clements, in the Strand, for electric light. Among other churches employing the same power are St. Jude's, South Kensington; the Temple Church and Holy Trinity, Sloane Square.

An Electric Omnibus in Palace Yard, Westminster.—Last Tuesday a number of members of Parliament were given the opportunity of testing the practical utility of the electric omnibus. The omnibus, which was in charge of Admiral Mayne, started from the St. Stephen's Club and after visiting the members' entrance in Palace Yard, made a series of trips among the neighboring streets. The electric omnibus appears to have given the greatest satisfaction.

Electric Welding.—The *Financial News* states that a company is being formed to acquire a patent of Mr. Coffin's for the welding of iron by electricity. He claims that by his invention iron of one inch thickness can be welded with single horse-power.

Verity & Sons vs. Terry.—This action by the well-known electric light engineers to recover nearly £600 for electric light installation at Terry's Theatre, in the Strand, was compromised by a payment of £375 and costs. Mr. Justice Charles said that no blame attached in any way to the plaintiff for what had occurred, and that Mr. Terry had electric lighting in his theatre equal to any lighting in London. The work had been thoroughly well done and the prices were fair, but it appeared that Mr. Terry had been absent while the work was being done and having already spent hundreds of pounds on electric lighting, he was surprised at the amount of the bill and decided to test the matter of his entire responsibility.

Telephones for Ireland.—In reply to a question of Mr. Dickson's in the House of Commons, Mr. Raikes, the Postmaster-General stated that there had been no public demand for a telephone service between Dublin and Belfast, communicated to the post office; but if the honorable member believed there was any such demand and would communicate with him, he would be glad to give the matter his best consideration.

The First Manufacture of Cable in France.—Submarine cable of French manufacture is now being finished at the works of the Société des Téléphones, at Calais.

Antwerp Electric Lighting.—At the late meeting of the Antwerp Waterworks Company reference was made to the pending negotiations for the lighting of the city of Antwerp by electricity. It appears the town has been for some time anxious to have the electric light, but the gas company and their own possessed monopolies. Both had, however, been approached and provisional contracts entered into. The necessary hydraulic power required at the local stations would be attained from the water company and the gas company, in consideration of an extension of their concession, agreed to give up their monopoly regarding the general desire of Antwerp for the electric light. The water company on payment of a royalty and with the understanding that they incurred no monetary risk or other responsibility, were willing that their water should be used for the purposes required.

Metropolitan Electric Supply Company.—The directors' report, to be presented at the fourth ordinary general meeting, is a very satisfactory one. As showing the immense growth of business, the revenue for the last three months of 1890 was nearly £11,000; for the same period in 1889 it was under £3,000. At the end of 1889 the lamp connections were 14,000; there are now 58,000, and the demand for light in the company's district is very steadily increasing. The working of the present year has been so encouraging that the directors have the strongest grounds for confidence in the immediate future of their company, and it has been decided to make an interim distribution of 2s. per share, payable May 1 next. The company's stations at Whitehall, Sardinia, Trent, Rathbone Place and Manchester Square, are now completed and in perfectly satisfactory working order. The new station for the Caddington district, for which the machinery is in a very forward state, will be ready for the Winter season's lighting. These stations, with mains and necessary plant, will absorb the present issue of capital, but as the demand for electric light increases, a further issue of capital will be made.

CHARLES FFRENCH.

London, April 20, 1891.

OUR CHICAGO LETTER.

Mr. H. D. Stanley, of the Bridgeport Brass Company, was in Chicago this week.

Mr. Lafayette Cole, representing the Holmes, Booth & Haydens Company, spent a day or two in Chicago recently.

Mr. R. E. Richardson, M. E., of the Electrical Engineering Company, has just returned from a pleasant trip through the South.

The Central Electric Company are placing on the market a new lamp cord, the covering of which is absolutely fire-proof. This will meet the requirements of some States where the underwriters have condemned the use of lamp cord that is not fire-proof. Commercial is the name, and it is the latest product of the Okonite Company.

The Demand for the Mosher arc lamp is increasing, several nice orders having been received this week. Those already using the lamps speak very highly of them.

Messrs. Kohler Bros. & Grier have perfected arrangements whereby they are to become the general selling agents of the new "Gem" incandescent lamp manufactured by the Thwing Electric Company, of Chicago. The names of the gentlemen composing the firm is sufficient guarantee of an immense sale of these goods.

Mr. C. B. Holmes, president of the Hazleton Tripod Boiler Company, reports large sales of this famous boiler; some recent sales made are: Three 500 horse-power boilers for the new electric railway plant at Memphis, Tenn. They will also furnish the entire boiler system in the power houses of the Davenport-Moline-Rock Island Electric Railway. Send for their new catalogue.

The Stockholders and Directors of the Burton Electric Heater Company had a very pleasant surprise ready for their new president, Mr. W. R. Mason, of this city, at the first meeting of this body held since Mr. Mason's election. He was given a pleasing reception, the whole party afterward adjourning to meet later at a highly enjoyable banquet.

The Interior Conduit and Insulation Company, through their Western manager, Mr. H. M. Underwood, have closed a contract whereby their entire system will be used in the new Fourteenth street pumping works. This contract will approximate 200 lights. The work of construction will be done by the Electrical Engineering Company, of 32 Dearborn street.

Mr. S. Dana Greene has accepted the position of consulting electrician of the Burton Electric Heater Company, of Richmond, Va. This will not interfere with Mr. Greene's connection with the Edison General Company.

The Electrical Engineering Company have contracted to furnish the handsome new "Dunshee" apartment building with a 30 horse-power Phoenix engine and a 250 light standard incandescent dynamo.

The Chicago Electric Motor Company have moved into desirable quarters in the Springer building.

Messrs. Bieckert & Nelson are about settled in their new quarters at 16 and 18 Franklin street.

One of our Large Supply Houses received the following order recently. It was somewhat amusing to read it. The order read something like this: Please send me at once

1 Editor.
1 gross Actresses.
1 dozen Apologies.
1 " Apothecaries and one gross Coffins.

This is all explained by looking through one of the Central Electric Company's handsome code catalogues.

The Sun Arc Lamp, which is controlled by the Great Western Electric Supply Company, has proven quite a success ever since the first one was installed. This lamp can be run either on the straight arc circuit or the incandescent. It was invented by one of the leading electricians of the country. He has recently perfected one or two improvements which have been added to the lamp. He will spend a month or so at the factory of the Great Western Electric Supply Co., and expects soon to place several more of his inventions on the market. The amount of territory covered by Chicago electric houses is a good deal larger than many people suppose. The Great Western Electric Supply Company have recently shipped a large order of supplies to the State of Maine. The Great Western also reports that there is hardly a State in the Union in which they do not do business.

Mr. J. W. Godfrey, general manager of the New York Insulated Wire Company, has been busily engaged during the past week locating and fitting up handsome offices in this city. This company have decided to open a branch in Chicago, and have secured two large floors at 78, 80 and 82 Franklin street, aggregating about 9,000 square feet of space. A full stock of the well known Grimshaw wire will be carried. Mr. Geo. H. Meeker, a gentleman well known to the trade, will have entire charge of the Western business. Mr. Meeker comes direct from the New York office, knows fully the desires of the trade, and will be glad to see his friends and the trade generally at all times.

Chicago, May 9. L. W. C.

OUR CINCINNATI LETTER.

The Electrical Supply and Contracting Company have the contract for a 15 light arc plant for Silver Grove Park, a new resort near Cincinnati.

The Standard Electrical Works have given up manufacturing and are now devoting themselves to electrical supplies. They report big sales of Okonite and Candee wire. They sold 36,000 feet of Candee wire this week to one party.

The Cincinnati Heat Regulating Company purchased 13,000 feet of Okonite wire from the Standard Electrical Works. They are running their system of regulation in the new Mabley Building.

The Card Electric Motor and Dynamo Company are getting out a large number of fine fan motors. The demand is much greater than ever before.

The Jones Bros. Electric Company, of this city, are increasing their power plant by the addition of a 300 horse-power Porter engine and two Stirling boilers.

The Cincinnati and Covington Electric Road have just opened a new route and their road is running with great success. They use the Short system.

P. C. Ackerman, of the American Electrical Works, was in the city yesterday on his return trip from the Pacific coast.

The Maysville Electric Road, of Maysville, Ky., is in operation with 3½ miles of road and extensions are being started for 1¼ miles. This road was constructed by D. J. Hauss, of Cincinnati, and is equipped with four Westinghouse motors, with seven trailers. The station has one 100 horse-power U. S. generator, two Greenwald 125 horse-power automatic engines, and two tubular boilers. A 650-light Thomson-Houston alternator and a 25 Thomson-Houston arc light machine are run from this same plant.

The Edison Company have started to dig up the streets here for their underground conduit, and the work is progressing very rapidly. E. S. M.

Cincinnati, May 5, 1891.

Air Navigation.

TO THE EDITOR OF ELECTRICAL REVIEW:

In the issue of May 2d, 1891, of the ELECTRICAL REVIEW I noticed some notes on air navigation, to which I would like to add some remarks, although I have not the least intention to join the immense number of inventors and designers of air-ships and flying machines.

In almost all the experiments on propulsion of air-ships a cigar-shaped form of the balloon has been chosen, because of the considerably smaller air resistance such a balloon has to encounter. This is the same reason why this shape has been used for torpedoes, cannon-shells, etc.

But the intention always was to point the balloon against the wind, independent of the direction of propulsion, so that by lengthening the body of the balloon, at least inside of certain limits, the frictional air resistance would not be increased very considerably.

The arrangement of the propelling mechanism *below* the metacentrum should be rather an advantage than a disadvantage; for the rotary movement given thereby to the air-ship would raise the front and lower the back end of the balloon, so that it takes an upward inclined position towards the wind, and after the principle of the first flying machine—and the most successful one—the *kite*, the pressure of the wind would hold the ship suspended in the air, so that, *if* only the propelling mechanism could be made strong enough, we would be enabled to do away entirely with the balloon and use only an inclined plane instead.

But all these considerations are only of secondary importance in comparison with the main difficulty, to get a motive power light enough and at the same time able to propel the ship at a halfways fair rate of speed.

Storage batteries will here be quite out of question, because even if the whole weight of lead could be made active, the stored energy of the battery is very small in comparison with its weight. Primary batteries will be slightly better and, indeed, some pretty fair results have been reached in experiments undertaken under the auspices of the French government. Comparatively the best results may be expected from gas engines, using the gas storage of the balloon. But the gas engine of to-day is still much too heavy a machine, so that for the first hardly much progress can be expected in air navigation.

CHAS. STEINMETZ.

Yonkers, N. Y., May 6.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, May 9, 1891. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co.	80¾
American Telegraph & Cable.	
Central and South American	145
Mexican	205
Commercial Cable Co.	105
Postal Telegraph Cable	30
Edison General Electric Co.	99
Consolidated Electric Light	
Edison Electric Illuminating Co.	76
United States Electric Light	30
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co.	*44¼
" " " Preferred	25¾
" " " Series C	9
" " " Series D	7
" " International Co.	
" Welding Co.	
" European Welding Co.	55
Ft. Wayne Electric Co.	*138¼
Detroit Electrical Works	
Westinghouse Electric Mfg. Co.	15¾
TELEPHONE:	
American Bell	
Erie	*48¾
New England	51¾
Mexican	
Tropical American	
MISCELLANEOUS:	
Edison Phonograph Doll	.50
WASHINGTON.	
Pennsylvania Telephone	23
Chesapeake and Potomac	58
American Graphophone	5¾
United States Electric Light (Washington)	163½
Eckington and Soldiers' Home Electric Railway	48
Georgetown and Tennallytown	62¾

*EX-Dividend.

Jas. A. Campbell & Company, electrical engineers and construction contractors for the Thomson-Houston system in Canada and the State of Michigan, will remove to much more desirable quarters at 55 Bagley avenue, Detroit. This company is doing a large business in central station equipment.

Telephone News

⁂ Cincinnati is to have long distance telephone service.

⁂ The Hudson River Telephone Company has awarded the contract to the National Conduit Company, of New York, to lay the conduit in Maiden lane, from North Pearl street to Eagle street, Albany.

⁂ An oath was administered by telephone the other day in New York. The telephone girls of Cairo know that this is nothing new, especially if the wires are crossed when one is in a great hurry.—*Cairo, Ill., Bulletin.*

⁂ The *Boston Beacon* understands that the New England Telephone Company is selling $500,000 six per cent. 15-year bonds at 102¼, which make a total funded indebtedness of $1,500,000. The money from the present sale is going largely into underground operations.

⁂ The Bell Telephone Company recently made an offer to the Toronto, Can., council of five per cent. of its gross receipts, 25 instruments for the city offices free, a police and fire service free, and a $25 house service on a three years' contract, in return for an exclusive franchise within the city.

⁂ In the $15,000 damage suit of August Johnson against the Northwestern Telephone Company, Judge Smith, of Minneapolis, has directed the jury to return a verdict for the defendant, holding that the company was not responsible for the damage caused by the falling of a wire-laden pole, when some one, not connected with the company, had cut the guy ropes holding it in place. The case will probably be appealed.

⁂ The force of habit sometimes causes ridiculous happenings, and this was the case of a certain young lady telephone operator employed in an office not 1,000 miles from Adams. It seems the young lady in question had been very busy on a certain day and retired at night pretty well tired out. Before retiring she set her alarm clock, which she kept in her room. She slept soundly all night. At the time set the alarm clock went off, but the young lady mistook it for a call, and, still asleep, she reached over the side of the bed, grabbed a shoe and placing it to her ear, began shouting "Hello, hello!"—*Adams, Mass., Freeman.*

Armstrong's Trailer Connection.

On most of the electric railways in this country the current is used to light both the motor cars and tow cars or trailers. For this purpose two pieces of flexible cord, hanging from the end of each car, are joined by a connection. Its two parts must be interchangeable, since the cars are apt to be turned end for end. It must have large contact surfaces, and spring catches must allow it to pull apart when a train separates, instead of breaking the cord. Several connectors now in use combine the above points, but as their projecting ends are always in circuit, any one handling them is apt to get a shock.

To avoid this unpleasant feature, Mr. Chas. G. Armstrong has designed a new connection in which the projecting metal parts are dead when disconnected. Each part has a brass spring catch as terminal for the cord, this catch being insulated from the projecting metal tip by a bushing of hard rubber. On putting the two halves together, each tip completes the circuit between the two metal parts of the other half. The contact surfaces are large, and the stiff springs insure a quick make and break. The end of each conducting cord is soldered into a brass tube as shown in the cut, and a knot in the cord takes the strain off this joint. The whole is put up in a tightly-fitting hard rubber shell and is not much larger than the illustration. It is well made and would seem to be just the thing for the purpose. It is being put on the market by Geo. Cutter, of Chicago.

A New Bi-Metallic Conductor.

"Bi-metallicism" is a term which has, in recent years, acquired a distinct meaning of its own, and refers, as everybody knows, to a very important question connected with the currency. We might apply the term with equal accuracy to a new development in the methods of transmitting electrical energy which is beginning to attract the attention of practical men; but it might lead to some confusion of ideas, and in all scientific matters lucidity should be a *sine qua non*.

Hitherto, in transmitting electricity through metallic conductors, the use of a single metal has alone been resorted to at all extensively, and experience has shown that of all the commoner metals copper presents the greatest advantages. If we take the conductivity of mercury to be unity, then, according to Matthiessen, we have the following values:

Silver	65.64
Copper	61.70
Gold	47.92
Zinc	17.52
Platinum	6.46

Silver is placed outside industrial application by reason of its costliness, etc., and hence copper has been uniformly adopted.

But copper, though excellent for conducting electricity, by reason of its low resistance to the free passage of the current, is by no means perfect, it is deficient in what may be termed *mechanical resistance*, and is somewhat easily stretched. A rod of copper whose transverse section is one square centimetre, when stretched with a force of one degree gives an extension equal to

$$\frac{1}{1{,}050{,}000{,}000\times 981}$$

of the whole length (Unwin and Wertheim), and it has not the tenacity which steel and wrought-iron, for instance, have.

It is only possible to maintain a great mechanical resistance by incorporating with the copper some foreign metals or substances which, while increasing its strength, seriously affects its high electrical conductivity. During the past four years a great deal of research has been prosecuted with a view to discovering some alloy of copper which shall successfully combine these desirable qualities of high mechanical resistance and low electrical resistance, so that it shall, when drawn into wire, meet the requirements of every case in which such conductors may be used, and be, at the same time, reasonably cheap.

Although a great many of these alloys have been proposed, few of them have received any attention outside the experimental laboratory. Those which have been more especially regarded with favor are the phosphoric and silicious "bronzes." Copper will combine with phosphorus directly under the influence of heat, or, when the metal is heated with bone-earth and charcoal, yielding a product which is grey, approaching to whiteness in color, and is very hard and brittle at ordinary temperatures. If, however, the proportion of phosphorus present be kept sufficiently low, the hardness and fusibility of the copper are increased, and if the proportions be copper, 1,000 parts, phosphorus, five parts, the tenacity is wonderfully improved.

The improving influence of phosphorus is seen in the so-called "phosphor-bronze," an alloy of copper and tin containing traces of this non-metallic element; specimens submitted to testing have withstood a tensile strain greatly in excess of that afforded by copper or bronze, and ranging as high as 74,966 pounds, that is to say, over 33 tons per square inch. And these figures have been greatly exceeded after "wire-drawing." In this case the elasticity has also been greatly improved. There was a proposal a few years ago to utilize phosphor-bronze for overhead wires, as it was asserted that when, through accident, such wires became severed they would not fall, and thus become a source of great danger, but would at once coil up and remain out of danger of doing any damage. Silicon has a somewhat similar effect upon the properties of copper when combined with it.

Now, although these silicious and phosphoric "bronzes" satisfied, to some extent, the exigencies of wire conductors, certain inconveniences attached to their use, combined with their high price, have prevented them from being universally adopted, and, one after another, they have been "dropped."

An entirely novel proposal has recently been made by a French engineer—Mons. Edouard Martin—which, it is alleged, is likely to become rapidly and widely adopted, since it refers to a really practical solution of the problem of wire conductors, and is not merely "another new scientific nostrum."

Mons. Martin has devised a compound or bi-metallic wire which consists of a steel core sheathed in copper. This, it is said, combines the desirable advantage of lightness, high mechanical resistance and cheapness, with a sufficiently low resistance to current for all ordinary practical purposes.

The resistance to elongation of the compound conductor varies according to its diameter, but it is always superior to that of steel alone. This appears rather astonishing, but the fact has been proved most emphatically by severe test experiments.

The electrical conductivity of the compound wire, referred to that of pure copper, has been determined to be about 60 per cent.

For the sake of fixing our ideas in comparing the new conductor with ordinary copper conductors, let us consider them as applied, say, to telephone work. A telephone wire of diameter 1.5 millimetre, and made of pure copper, will possess a very convenient conductivity, but will not possess sufficient mechanical resistance to enable it to stand all the strain which it might reasonably be expected to have to contend with. Now, to obtain the same conducting power, one of Martin's bi-metallic wires need only possess a diameter of 1.9 millimetre, yet it will have a mechanical resistance which will be equal to all ordinary emergencies.

Armstrong's Trailer Connection.

Dr. A. Laisant, who has made careful experiments with these bi-metallic conductors, states, that to enable a copper wire to stand all the ordinary strains which it is likely to meet with when in use, a minimum diameter of 2.5 millimetres would be necessary. Such a thickness would mean a weight of 43.700 kilogrammes per kilometre, and it would cost, according to the presennt price of copper, say, 91.75 francs per kilometre. On the other hand, a bi-metallic wire, made according to M. Martin's idea, need only be 1.9 millimetre in diameter in order to possess sufficient conductivity and strength for ordinary telephonic purposes, yet it would weigh only 25.35 kilogrammes per kilometre, and would cost only 48.15 francs per kilometre.

These wires are being manufactured on a commercial scale by a patented process by Mons. Martin, at his works at Joinville-le-Pont, where specimens are drawn varying in diameter from a tenth of a millimetre to upwards of a centimetre, the proportion of the iron and steel being determined by the value of the conductivity required for any given purpose. There is one objection which naturally presents itself to one's mind; copper and steel possess different coefficients of expansion, copper being .000017178 and steel, not tempered, .000010792.

One might, therefore, naturally suppose that when the bi-metallic conductors are subjected to varying temperatures, some disturbance would arise owing to the inequality of the expansion of copper and steel. No doubt some action does take place, but in actual practice, which is the important consideration, no disadvantages have been found to arise.

Dr. Laisant proposes to make some exact determination with regard to the behavior of the compound wire under variation of temperature; but considering the results which have been obtained in practice, it is not anticipated that they will bear any influence of value upon the industrial applications of the new conductor, though such quantitative experiments will possess a certain interest from a scientific point of view.

If a further word is necessary to establish the practical importance of this discovery, it is sufficient to state that the *Administration des Télégraphs* in France and several foreign governments have already placed large orders with Mons. Martin.—*English Mechanic and World of Science.*

Engineering Association of the South.

The Regular Monthly Meeting of the Engineering Association of the South was held at the Y. M. C. A. Building, Nashville, Tenn., on the evening of April 9, 1891, with First Vice-president W. L. Dudley presiding and about 25 members and visitors present.

The Death of Mr. H. S. Butler, of Anniston, Ala., was announced to the Association and Messrs. E. C. Lewis, Nashville, Tenn.; W. H. Spradlin, Gallatin, Tenn.; W. M. Newbold, Birmingham, Ala., were appointed a committee to prepare a biographical sketch of the life of Mr. Butler.

The Following Resolutions relative to the forthcoming annual convention of the American Society of Civil Engineers were adopted:

Resolved, That the Engineering Association of the South has learned with gratification of the selection of Lookout Mountain, Tenn., as the place of the meeting for the forthcoming annual convention of the American Society of Civil Engineers which is to convene May 20, 1891, and that it extends to the American Society a hearty welcome to the South.

Resolved, Further, that the American Society of Civil Engineers be invited to include the city of Nashville, the headquarters of this Association, in its route to or from Lookout Mountain and if practicable to hold one session of the convention in Nashville.

On motion the chairman was empowered to appoint a committee of five to carry out the wishes of the Association in the matter of courtesies to be extended to the American Society of Civil Engineers which committee was authorized to place itself in communication with the Committee of Arrangements of the American Society of Civil Engineers and learn its wishes.

The paper of the evening, entitled "The Engineering Profession," was then presented by Maj. W. F. Foster of Nashville. The paper treated the subject under three heads: First, the relation of the members of the engineering profession to one another; second, the relation of engineers to their clients; third, the relation of engineers to the general public. The writer held that engineers in charge of work should take a greater interest in the welfare and professional advancement of their subordinates and that a spirit of mutual aid and good faith should be characteristic of the intercourse between engineers, rather than one of professional reserve and criticism. No tolerance should be shown to pretenders or charlatans, for whose exclusion it was suggested that it might become desirable to inaugurate a system of State examinations and licenses. Maj. Foster dwelt strongly on the importance of engineers maintaining their true status as arbitrators between their clients and their contractors, and not simply act as the agents of their clients; it would be disgraceful for an engineer to receive a bribe from a contractor as an inducement to accept inferior work; it would be equally dishonorable that he should allow his salary to be the bribe to do injustice to the contractor in the interest of his employer. The writer was of the opinion that while not generally desirable or proper, still, in certain cases under certain conditions and clearly defined stipulations, professional work might be undertaken for a fixed compensation regardless of the time or the difficulties to be encountered. The practice, however, of bidding for engineering work was held to be all wrong in theory and bad in effects, undignified and unprofessional and a practice to be discouraged as lowering the high standard of the profession.

Removal Notice.

We are informed by Mr. John W. Beane, secretary and treasurer of the National Electric Light Association, that the offices of this association are now located at No. 136 Liberty street, instead of 18 Cortlandt street. This is the new Electrical Exchange Building, and makes a very convenient location for the association.

The Reflecting Galvanometer—Your Use of It and Its Abuse of You.

To the Editor of Electrical Review:

The galvanometer has been generally described in books and articles hitherto, "as an instrument for measuring an electric current." But its powers in this line are very limited and it has been given a great deal more credit than it deserves.

In fact, the reflecting galvanometer, "as I have found it," is one of the most over-rated self-inflated bits of humbug in the whole range of the electrical world. It was born of parents who were neither particularly poor nor particularly humble, at a time when the technical knowledge of the then so-called "telegraph engineer" was about equal to that of the average press reporter in electrical matters of to-day. And at that period it was looked upon as a prodigy of human skill and inventiveness and the very acme of delicacy and refinement. Was received with all the honor due to its wise father, Prof. Thomson, and its advent was blazoned forth to the world as the savior of all electricians and the solver of all electrical problems.

It was then a very simple-minded sort of affair, a coil of fine wire of about three inches diameter wound round a hollow spool with a piece of looking glass hung by a silk tape in its center. Then it was a sensible, well-conducted thing which gave itself no airs, but did its work steadily and reliably.

Its little reflector threw a ray of light into some of the darkest electrical questions of that day, and commercially saved the first Atlantic and other cables. Everybody liked it and smiled upon it and electrical outsiders were quite honored by being introduced to it and proud of boasting of its acquaintance. It was a boon and a blessing then. Now it throws its ray of light all over the place, and is only welcome to those who are in want of a good honest excuse for indulgence in vigorous profanity. It has imperilled the hereafter and darkened the present of many a good man who otherwise would have been a credit to the Salvation Army. It is doubtful if the venerable Professor Thomson himself knew at the time he was inventing it what it would eventually develop into. If he had known, I think he would have rather said to himself, "Being a Christian man, it is my duty not to give my invention to the world but let it die with me."

If he had, what a lot of space would have now been unoccupied in those lower regions of terror so dear to the "truly good" and how many now on earth would be peaceful ordinary men, instead of being wicked, unprincipled, impetuous students in profane objurgation, without respect for aught and at war with all above, below or between! I have been years at it myself, and can tell a galvanometer man in a crowd. His countenance bears the mark of patient endurance and self restraint. When he speaks to you his mind is still galvanometrical and he is mentally taking your capacity. He fixes some spot on your person, touches a button on your coat, and at once runs his eye to another spot which he also fixes for an instant, and after mentally noting the amount of visual deflection, seems doubtful and wants to do it all over again. Then he comes to his senses and speaks and you find the man you once knew as an energetic active pushing youngster no longer exists. He has become a watcher for feeble rays of light in darkened places and the man is crushed out of him. Had Professor Thomson's original bantling been left alone as he made it, the world would have been just as wise electrically and much better morally than it is to-day. But the simple little beauty was not good enough for the electrical generation of that day and this, and they, of course, began to improve upon it. They put shunts on it, they devised special keys for it (one with eight connections), they made the wire finer and longer, they made the mirror smaller and lighter, and put four or five magnets on it instead of one. Then they compounded it, thick wire and fine wire, and worked up the law of derived currents to give it a characteristic value. Then they differentiated it, then they put two sets of needles on it and made it astatic and differential. Then they diminished the fibre to make it too sensitive to be fit for much, then they put on it a beautiful aluminium vane to reduce its sensitiveness. Finally, they hung the mirror on a single fibre of silk which will break at a few grains and tied it in a brass wire fixed in a friction clamp, so that pounds pressure were required if you wanted to raise or lower it.

This involved the blessing of a broken fibre, for which the judgment is passed on you to replace it. Every time this is done you are 10 years older. Then they put it on beautiful polished rubber, with burnished leveling screws and covered it with the finest brass work and beveled plates of polished glass and crowned it with a directing magnet, mounted on a micrometer screw so that you could move it the millionth of an inch, when the least touch of your hand would upset it for an hour.

The result is one of the most supersensitive, unsatisfactory, trembling, self opinionated and temper-trying instruments human ingenuity has ever devised. Beautiful to look at, mysterious and awe-inspiring to the uninitiated; only the man who is familiar with its vagaries knows what wreck it has made of many a temper, once strong enough in its goodness and philosophy to resist the assaults of all worldly care and misfortune, but which now has utterly succumbed in front of a "Thomson astatic reflecting galvanometer of 10,000 ohms resistance."

The worried galvanometer man and Lady Macbeth can both say with equal fervor, "Out, out damned spot." They never knew one another, although the galvanometer man, perhaps, knows more of her than she will ever know of him. They may, however, meet hereafter, and it may console him to know that the world will say that his excuse was greater than her's. J. D. B.

New York, May 9.

An Improved Electric Light Signal.

The McCann & Creider electric light signal is a device designed with a view of assisting the operation of the block system of railroad signals, or answering the purpose of the same when the road is not already fitted with the block system. At regular intervals along the track a post with a signal lamp, signal box and telephone is erected. There is no limit as to the distance these posts may be placed from the operator's house, as the light is operated from storage batteries located at the posts, the local circuit being opened and closed by the signaling device. Should any danger arise along the road or a mistake in train orders occur, the operator can turn on a danger signal, stopping the train at any one of these posts. The engineer or conductor will open the box and telephone to the operator, receiving instructions as to how to act.

In a cylinder of insulating material a number of brass contacts are set, which are metallically connected to the shaft of the cylinder. In one circle there will be five points of contact, in another 15, in another 25, and so on. The cylinder in revolving once will make and break the current, according to the number of contacts that are placed in the circuit. A brush bears on every circle of contacts, and the shaft is connected to one side of the circuit while each brush is connected to the other side by means of a plug switchboard; but only the brush that is plugged in the circuit will be active. The cylinder revolves once and communicates the impulses of the current to the line as the brush, which is in circuit, passes over the contact pieces.

The signal boxes on the posts along the line have a metallic brush bearing on the rim of an insulated disk. This disk has brass contact pieces through which the local current from the contact pieces can be thrown into circuit and the lamp lighted. Each signal box is set so that a certain number of impulses will operate through the action of an ordinary spool magnet and work the simple mechanism, closing the local circuit. The operator, by means of the cylinder at the station, produces the desired number of impulses to turn on any light, and by aid of an indicator he knows at once the position of the mechanism of any of the signal boxes. Should it be necessary to turn on all lights, it can be done, and when the signal boxes are reset, which is done from the station, he can at once, by the aid of the indicator, see if they are correct.

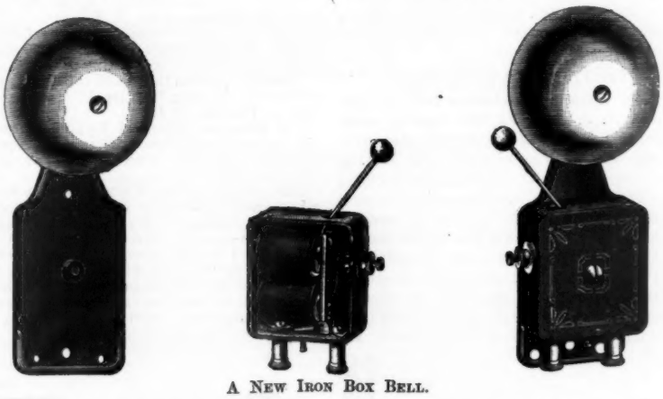
A complete model of this device has been on exhibition at the Grand Pacific Hotel, of Chicago, for some time past, and has received the attention of many eminent railroad specialists.

Mr. McCann has another and extremely simple device—a door bell annunciator or push button. The button operates the drop mechanically so as to pull it part way down. When the current is on it will draw the drop twice as far by the aid of a magnet. There is room for two signs on the drop, as "IN" and "OUT." A small two-joint switch is placed in the main circuit somewhere in the house. If the person is out, the switch is open and the annunciator at the door will show "OUT." If the current is on, the magnet will draw the drop down and show "IN." This arrangement could be used in many places and various signs could be put on the drop. The inventor terms this device the "Automatic Prevaricator."

A New Iron Box Bell.

W. R. Ostrander & Company, 195 and 197 Fulton street, Brooklyn, have just put upon the market the iron box electric call bell illustrated on this page.

The armature has bottom and side adjustments, and is pivoted in such a manner that although it works very freely, it is impossible for the points to get out of contact.



A New Iron Box Bell.

It can be adjusted to ring on one cell of battery. The contact points are made of platinum wire, riveted in, and the armature spring is phosphor-bronze.

The hammer rod is twisted in the armature so that it is impossible for it to work loose.

The mechanism is all in the box, which is held to the back plate by a center screw.

The back plate, when once on the wall, need never be taken down. To get at the mechanism it is only necessary to remove the box.

In making this bell, only the best of materials have been used, and the manufacturers feel certain that this bell is as nearly perfect as possible in every respect.

Photoelectricity.

Prof. G. M. Minchin, at a meeting of the Physical Society, January 16, read a paper on the electromotive force developed by light falling on sensitive plates which were immersed in suitable liquids. The blue end of the spectrum was found to be the most effective. Currents have a photographic effect on the plates, and this action is strictly confined to the parts through which the current has passed. Comparatively strong currents were obtained from plates coated with eosine and gelatine. A Hertz oscillator restored the sensitive state in a cell placed at a distance of 81 feet. An arrangement of 50 cells in series with an electrometer was exhibited, by means of which light falling on the cells could generate sufficient electromotive force to ring a bell or light an electric lamp.—*Nature.*

TELEGRAPHIC

.... It looks as if the New England Printing Telegraph Company would have to hang its wires on a weeping willow tree, for lack of the necessary poles.—*Boston Herald.*

... The *Call* Publishing Company, of Lincoln, Neb., has brought suit against the Western Union Telegraph Company for $1,900. The *Call* claims discrimination in the matter of receiving the Associated Press report, and says it pays five times as much per word as the *State Journal.*

.... The messenger boys in the Portland, Me., offices of the Western Union and Commercial Union Telegraph Companies, to the number of 28, and including all the messengers in the city, struck recently for an advance in wages. They have been getting 2½ cents for messages and want 3½ cents. The boys make from $4 to $6 a week and in Summer make as high as $7 a week. Men in teams are now doing the messenger service. The strikers will be paid off and other boys engaged in their places unless they return to work.

.... The Pacific Postal Telegraph Cable Company threw open the doors of its new San Francisco office to the public on May 1. The new quarters are very spacious and equipped with every modern appliance of telegraph service. Examples of the service this company can give were shown at the opening when messages were sent to London, Canso, Nova Scotia, New York, Washington, D. C., Montreal, Portland and Seattle, and in about seven minutes answers had been received from every point in question. A fine, large, silken souvenir invitation to be present was sent to President Harrison.

Annual Meeting of the New England Telegraph and Telephone Company.

The annual meeting of the stockholders of the New England Telegraph & Telephone Company was held in New York, Monday of last week. The following named officers were elected: President, Thomas Sherwin; vice-president, Henry S. Hyde; treasurer, William R. Driver; general manager, J. N. Keller; directors, F. Ayer, L. F. Beckwith, J. H. Cahill, J. P. Davis, B. C. Dean, W. H. Forbes, E. W. Reel, J. T. Hudson, H. S. Hyde, J. Jameson, J. Kavanaugh, E. P. Meany, M. G. Parker, S. Salisbury, W. D. Sargent and T. Sherwin.

The annual report shows the following result of operations for the year ended December 31, 1890.

	1890.	1889.		
Gross	$1,383,668	$1,255,570	Inc.	$128,098
Expenses	1,045,038	957,305	Inc.	87,733
Net	$338,630	$298,265	Inc.	$40,364
Dividends	298,265	270,726	Inc.	27,539
Surplus	$40,365	$27,539	Inc.	$12,826

The balance sheet shows as follows: Assets—Licenses, $4,268,000; plant, $6,678,991.04; trustee stock, $231,000; stocks and bonds, $26,000; real estate, $16,271.50; construction (for the year 1890), $351,002 25; office furniture, teams and tools, $33,817.41; bells, material and supplies, $265,219.77; accounts receivable, $199,935.40; cash and deposits, $149,504.41; total, $12,219,741.78. Liabilities—Capital stock, $10,394,600; surplus account, $373,675.72; bonded debt, $1,000,000; income account, $181,130.05; reserve account, $237,139.11; accounts payable, $33,196.90; total, $12,219,741.78.

The number of subscribers December 31, 1890, was 21,967, against 20,553 December 31, 1889, an increase of 1,521. The expenditure upon plant and equipment was $765,153, against $654,438 in 1889. There was charged to new construction $351,002, of which $159,369 was expended for underground work. It is estimated that $760,000 will be expended for extension and maintenance in 1891.

* * Seventy-two citizens of Cairo, Ill., have subscribed $50,000 for an electric road.

* * The street car company at Aurora, Ill., sold all its mules at auction last week. Cause: Electric railway.

* * The Flushing, L. I., and College Point Electric Railroad has been mortgaged to the Atlantic Trust Company for $150,000.

* * The city council of Warren, O., invites bids until May 22 for carrying passengers over a proposed electric road at that place.

* * A correspondent writes as follows about the electric road which it has been rumored would be built from Rochester to Niagara Falls:

"This road is proposed to be built along the well known highway called the "Ridge Road" once the shore of Lake Ontario, now an almost perfectly level road from Hamilton, Ont., to Sodus, Wayne County, N. Y. An electric railroad 80 miles long, through a purely farming country passing through no large villages seems such an absurdly impractical scheme, that it would call for no attention except that impossibilities five years ago, are facts now. I cannot find that any well known capitalists are interested."

Model Motive Power.

The Baltimore and Ohio Railroad Company has recently placed in service on its fast trains between New York, Philadelphia, Baltimore and Washington, three new engines which are doubtless the finest and fastest ever built in this country. These new flyers have driving wheels six feet six inches high and cylinders 20 inches by 24. The large cylinders give them tremendous power and the high drivers protect the machinery from the rack and strain incident to driving smaller engines at greater speed. There is practically no limit to the speed to which these new marvels may be driven and they skim over the rails as smoothly as a swallow over a lake.

Another recent addition to the motive power of the company is a consignment of eight powerful ten wheel passenger engines, designed for service on the mountain divisions. These are the heaviest 10 wheel engines ever constructed, weighing 67½ tons. They have driving wheels six feet two inches high and cylinders 21 inches by 26. One of these machines performs the work heretofore requiring two of the ordinary class and they take the heavy through express trains up the mountain grades quickly and with perfect ease.

The Mt. Clare shops of the company have recently completed an order for 10 switch engines of the highest type, and sufficiently powerful to make up a train equal to the full drawing power of a consolidation freight engine. Also three new heavy eight wheel passenger engines, having driving wheels five feet eight inches, and cylinders 20 inches by 24. These engines are now doing excellent work; they are very powerful and susceptible of great speed.

In addition to the foregoing the company has now under construction at its Mt. Clare shops 10 powerful 10 wheel engines designed for fast freight service and for heavy passenger trains on occasion, also 12 consolidation freight engines of great power.

These additions to its motive power are in line with the other great improvements constantly being made in the general betterment of the B. & O. property by its present management, which have been noted by the press from time to time, and the rapid augmentation of the passenger traffic of the company indicates that the public is quick to recognize the present and constantly increasing efficiency of its train service.

The Cobb Wire Company in Trouble.

The Cobb Vulcanite Wire Company, of Wilmington, Del., is in financial trouble. Attachments, it is said, have been obtained against the company, and it is reported that it will not be able to meet its obligations. The present officers of the company are: Edward T. Davis, president; Charles W. Trump, vice-president; John F. Miller, treasurer; T. Darlington Smith, secretary.

ELECTRIC CLUBS.

New York Electric Club.

A Pleasant Dinner occurred at the Club House, Tuesday evening of last week. It had been arranged by a committee composed of Messrs. P. H. Alexander, C. D. Shain and Chas. Dutton. President Insull was present part of the evening, and was the first of the after-dinner speakers, and spoke earnestly in favor of the future growth and development of the Club, paying a kindly tribute to his predecessors in office, ex-presidents Davis, Gilliland and Madden, for excellent work done. Other entertaining speakers were Chas. Dutton, Edward Weston, Geo. M. Phelps, Stephen L. Coles, T. C. Martin, H. B. Cram. There were about 30 gentlemen present, among whom, in addition to the speakers, were Chas. A. Hamilton, C. O. Baker, Jr., E. F. Peck, Geo. Prescott, Jr., W. R. Brixey, Chas. W. Price, Jos. Wetzler, P. H. Alexander, R. B. Corey, Geo. T. Manson, E. E. Bartlett, F. R. Colvin, Jos. Barré, W. S. Perry. Music and flowers added to the evening's enjoyment.

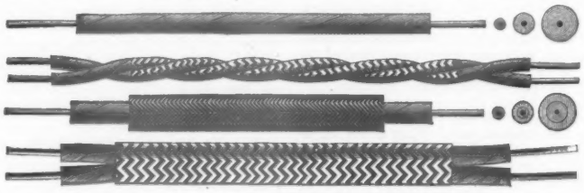


FIG. 1.—HOUSE LEADS OF THE NORWICH INSULATED WIRE COMPANY, NEW YORK.

Buffalo Electrical Society.

At a Meeting of the Society, held the evening of May 4, Mr. Frank Kitton read an interesting paper on the "Tangent Galvanometer."

The Franklin Club of Newark.

The Franklin Experimental Club, of Newark, N. J., held its 31st regular meeting at the Club Laboratory, Tuesday evening, May 5. The president, Mr. Wm. J. Hammer, read an interesting paper entitled, "The Arc Light." As illustrating the rapid development of this industry, the speaker instanced the fact that while there was exhibited at the Centennial Exposition in Philadelphia in 1876 but a single arc system, the Wallace; now arc lamps are burning everywhere and are numbered by the thousand and the hundreds of thousands. Mr. Hammer summed up the problems confronting the arc light men and spoke of the field for invention in alternate current lights. The paper was illustrated by diagrams prepared and mounted for the occasion. Mr. F. M. Crane spoke on electric railroads. He compared the three systems which are striving for supremacy in this field, the trolley, the storage and the conduit.

At the Next Meeting, May 19, Prof. Geo. C. Sonn, will deliver a paper on the phenomena of earthquakes, and will illustrate with lantern slides. Mr. Earl Atkinson will speak on motors.

American Institute of Electrical Engineers.

The Annual Meeting of the Institute for the election of officers for the ensuing year and the transaction of other business, will be held at the headquarters of the Institute, 12 West Thirty-first street, New York city, Tuesday evening, May 19, at eight o'clock.

The terms of all the officers, except the following, expire on that date in accordance with the rules:

Vice-Presidents — Francis B. Crocker, Frank J. Sprague, Joseph Wetzler.

Managers—Dr. F. Benedict Herzog, Dr. Wm. E. Geyer, H. C. Townsend, Francis R. Upton, J. C. Chamberlain, P. B. Delany, Horatio A. Foster, H. Ward Leonard.

An official invitation has been extended to the Institute to be represented at the electrical congress of the Frankfort Exhibition. It is expected that delegates will be appointed and instructed accordingly.

After the adjournment of the annual meeting, Tuesday evening, the Institute will visit and inspect the Twenty-sixth street station of the Edison Illuminating Company.

The general meeting begins Wednesday, May 20. The morning session on Wednesday will be called to order at 10 o'clock by the president.

The following papers will be read:

"The Development of the Dynamo," by Prof. Harris J. Ryan, of Cornell University.

"The Evolution of the Stationery Electric Motor," by Dr. Schuyler S. Wheeler, of New York city.

"Some Data Concerning the Photometry of the Arc Lamp," by Dr. Edward L. Nichols, of Cornell University.

At 1 P. M. a recess of one hour will be taken. A collation will then be served.

At the afternoon session, 2 o'clock, Wednesday, May 20, the following papers will be read:

"A New Graphical Method of Calculating Leads for Wiring," by Mr. Carl Hering, of Philadelphia, Pa.

"Street Car Motor Design," by Mr. H. F. Parshall, of Schenectady, N. Y.

"Recent Improvements in Printing Telegraphs," by Mr. Henry Van Hoevenbergh, of New York city.

"Some Results in the Practical Utilization of Electric Welding," by Dr. F. A. C. Perrine, of Trenton, N. J.

"A Proposed Electrical Equipment for the Coming Rapid Transit System of New York City," by Mr. Frank J. Sprague, of New York city.

The evening session, Wednesday, May 20, will be held in Professor Dwight's room at Columbia College, Forty-ninth street and Madison avenue, at 8.30 P. M. A lecture will be delivered by Mr. Nicola Tesla, of New York city, on "Experiments with Alternating Currents of High Frequency." This will be illustrated by practical experiments with special apparatus devised for the occasion. Ladies are invited to attend this lecture.

On Thursday, May 21, the members will assemble at the Crocker-Wheeler Motor factory, at 9.30 A. M., where, upon invitation of the Crocker-Wheeler Motor Company, an opportunity will be offered to inspect the improved machinery used in the construction of motors. The members will assemble at 12 West Thirty-first street, at 11 o'clock, when the following papers will be read:

"A New Device for the Measurement of Alternating Current Potential," by Prof. George S. Moler, of Cornell University.

"A Study of the Fluctuations of Electromotive Force in the Open Coil Armature of a Constant Current Machine," by Mr. M. E. Thompson, of Cornell University. A recess of one hour will be taken and a collation served.

At the afternoon session, 2 o'clock, Thursday, May 21, will be read these papers:

"Electric Meters," by Mr. G. W. Walker, of New York city.

"The Aluminum Problem—Retrospective and Prospective," an address by Dr. W. H. Wahl, Secretary of the Franklin Institute.

"Shall Aluminum be Alium?" by Mr. Oberlin Smith, Past-President of the American Society of Mechanical Engineers.

The manufacturers of aluminum products and alloys have been invited to unite in an exhibition of specimens of their work in this line.

The Electric Club has courteously extended to the Institute the full privileges of the Club House, 17 East Twenty-second street, during the period of the meetings. Thursday evening at 8 o'clock, a reception will be tendered to the Institute at the Club House. Special interest will be given to this reception by reason of the fact that the entertainment committee of the Club has arranged for a loan exhibition of early electrical books, apparatus, models and paintings.

The headquarters of the Institute are convenient to the Thirty-third street station of the Sixth Avenue Elevated Railroad, or the Broadway horse cars, and will be open from 9 A. M. to 11 P. M.

The following hotels are in the vicinity:

Grand Hotel, corner Broadway and Thirty-first street.

Hotel Imperial, corner Broadway and Thirty-second street.

Gilsey House, corner Broadway and Twenty-ninth street.

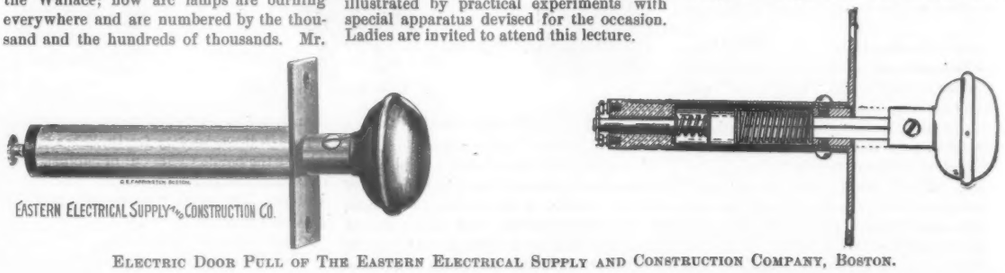
Sturtevant House, corner Broadway and Twenty-ninth street.

Eastern Electric Door Pull.

Our illustrations on this page show an electric door pull just put upon the market by the Eastern Electric Construction and Supply Company, Boston. The cut on the left is a perspective view of this device. The illustration on the right gives a central longitudinal section of the device, showing the pull at rest.

In the drawings, *A* represents any ordinary handle for a bell-pull, and *B* the escutcheon fixed to the door-frame. This escutcheon is recessed on its face at *b* about the central opening b^1 through it to afford a seat for the end of the shank *a* of the pull. On the inner face side of the escutcheon is fixed the hollow projection b^2, to which the cylinder or sleeve *C* is fixed at one end by screws *c*. This cylinder has inside of it the most of the operative or movable parts of the device, and is of proper length and size for that purpose.

The spindle a^1 of the pull is located within the cylinder *C*, and is adapted to be moved back and forth through the projection b^2 and the opening b^1 in the escutcheon. Between its end and the inner face of the escutcheon is placed around the spindle the spiral spring *D*, by means of which the handle is automatically returned to position and kept normally against the escutcheon, as shown. When the pull is drawn out, to ring the bell, the metal spindle *E*, which is beyond but in alignment with the pull-spindle a^1, is forced inward by spiral spring *F* about it, fixed between its headed end *e* and the hard rubber piece *G*, which is fastened by any suitable means in the outer end of the cylinder or sleeve *C*, leaving a portion of it beyond the cylinder. This movement of the spindle *E* brings its metallic head *e* in contact with the binding posts *H* H^1, fixed in the hard rubber and completes the electric circuit between the wires *I* I^1. When the connection is made the spindle *E* is completely insulated.



ELECTRIC DOOR PULL OF THE EASTERN ELECTRICAL SUPPLY AND CONSTRUCTION COMPANY, BOSTON.

The Norwalk Electric Light Station.

The Norwalk Electric Light Company's station was burnt down one Sunday morning last month at 8:30 o'clock, all the dynamos being destroyed. By the Tuesday evening following, the dynamos had been replaced and the station was in operation. The Schuyler system is used, and the prompt way in which the Schuyler Company helped out the local company was a source of great elation to the citizens of Norwalk. The old steam engines were used but run in an adjoining building. They are operating at the present time in Norwalk 1,500 incandescent lamps and 200 arc. This is one of the most successful lighting companies in the country. It started in October, 1886, and since then has paid 17 quarterly dividends of two per cent. each. Gen. Charles Olmstead is the president; Chas. E. Dustin, treasurer; J. H. Hoyt, secretary, and J. B. Avery, superintendent. The Norwalk company is one of the best managed local lighting companies in the country, and shows what good management with an excellent system may accomplish in this field.

Paper Insulation for Telephone and Telegraph Cables.

To the Editor of Electrical Review:

It is not many years since gutta-percha and india-rubber were regarded as being, if not the only, certainly the best insulators for electrical conductors. For submarine work they still stand pre-eminent in every good quality, but for underground and in positions in which conductors insulated with these materials are exposed to changes of light and heat, they are not so durable.

But it was soon discovered that these gums possessed more permanent qualities, when either by design or accident they were adulterated with some other material. From thence sprung a host of compound insulating mixtures of which rubber is generally the base, and the other ingredients, powdered mica, asbestos, black lead, sulphur, and even powdered glass, has been tried.

Others have been tried in which the base of the compound is ozokerite or some other form of so called "mineral wax."

As insulators these answer the purpose intended to a greater or lesser degree. Some few are nearly perfect, whilst others are mere secret or patented "moonshine."

But the best of these insulators have inherent defects in other directions, which are serious drawbacks to their use for underground, telephone or telegraph cables, in which a number of conductors, sometimes as many as 150, are crowded into a small cable not much exceeding two inches in diameter. The specific inductive capacity of these compounds is so high that talking becomes difficult on these cables when used on telephone circuits, and on telegraph circuits also it lowers their efficiency.

Now, in neither of these cases is a very high insulation required, and it may be sacrificed within very wide limits, if lowering the capacity can be secured by so doing.

Inventors have, therefore, done much to find a material which will have a sufficiently high insulation and yet have a low inductive capacity. Amongst others, manilla fibre and cotton saturated with paraffine or ozokerite have been used with considerable success, but their high inductive capacity, although lower than compounds of rubber and gutta-percha, was still objectionable.

The material which has best succeeded in lowering the capacity of cables carrying either one or a hundred wires, is paper, and it is to the development of these that the Norwich Insulated Wire Company has devoted much capital and an untiring system of trial and investigation.

The results may be briefly summed up in this remarkable statement that whilst 18 or 20 months ago the capacity of one of their paper telephone cables, made to the United States Conference Standard (viz: 102 conductors, No. 18, B. & S., insulated to .125, encased in lead pipe one-eighth inch thick and two inches outer diameter), was as high as .22 Mfds. per mile, some of the company's cables now measure less than .085 Mfds. per mile, whilst the insulation is double and treble that ever required in practice. This is an enormous improvement, showing the lowest capacity ever obtained on a cable of such dimensions, either on this or the other side of the Atlantic.

The process of manufacture is very simple, but one requiring the greatest care and watchfulness. The paper is especially made for the purposes of this company in rolls from half a mile to five miles long, and weighing from 20 to 90 pounds per ream.

These rolls require to be kept for some months before using, thus necessitating a large stock being kept on hand.

When fit for use they are cut up into strips which are applied in overlapping spirals round the conductor by special patented machinery. The wire is then twined or twisted together in pairs, which are cabled in layers. The cable when completed is tested, and if satisfactory removed to the lead house where it is dried in ovens, compounded, lead covered and, finally, scrupulously examined, again tested, and reeled on drums ready for shipment. The lead covering is laid on in one continuous length by machinery constructed from designs and under patents of Mr. J. D. Bishop, who is the electrical engineer of the company. The company has been at work night and day turning out these cables, of which some 70 miles, containing over 7,000 miles of conductor, are already laid in Brooklyn and New York alone. Five of them may be seen on the mid-girders of the Brooklyn Bridge, exposed to the greatest extremes of temperature.

In practice these cables give extraordinary results. No difficulty whatever is found in splicing them. They are light and flexible, and, so far as the experience of the past four years go, they improve by age.

The company also makes electric light and power cables, and have recently shipped to England, Germany and France, considerable lengths of 10,000 volt Ferranti, concentric and other kinds. The officers of the company are Messrs. Louis D. Beck, president; Anthony Dey, vice-president; and E. D. McCraken, general manager.

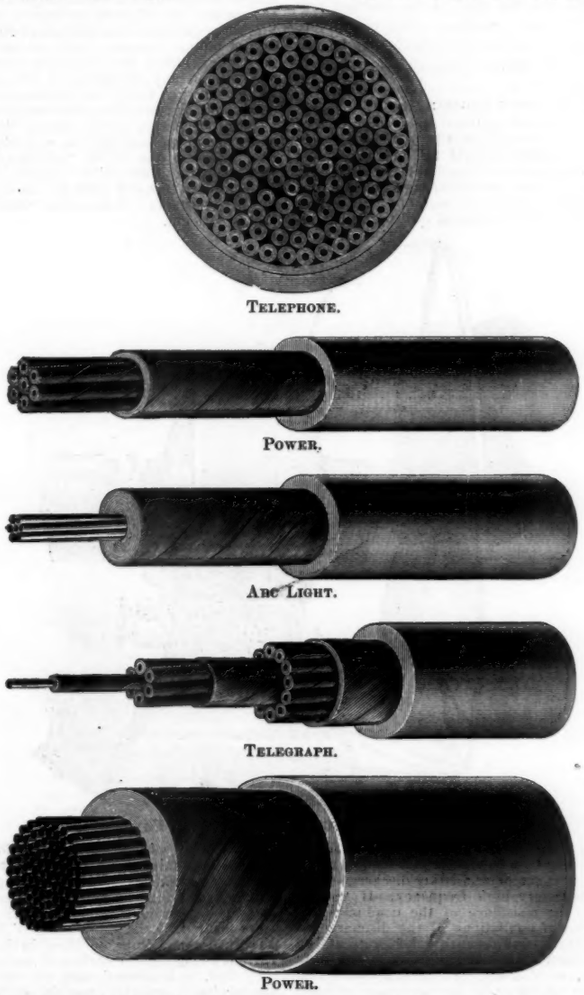


Fig. 2.—Cables of the Norwich Insulated Wire Company, New York.

Under their vigorous management the capacity of the works has been recently increased to over a mile of Conference Standard telephone cable, leaded complete, per diem, of which we show a section in an engraving.

It can also turn out 10 miles per week of ordinary arc light conductor, in addition to a large quantity of paper insulated leads for incandescent house and office wiring, shown in the accompanying illustrations.

The offices of the company are at 58 Cedar street, New York, and the factory is at Lorimer and Bayard streets, Brooklyn.

The Western Union Telegraph Company re-opened an office at Warren, Tex.

The Western Union Telegraph Company reported to the comptroller the number of messages sent within the State of Texas for the quarter ending March 31, as 168,775. The tax of one cent on day and one-half cent on night messages for that period amounts to $1,566.

The Meeting of the Westinghouse Company.

Half a hundred shareholders were present when General Manager Bannister called the meeting to order in Pittsburgh. Then President Westinghouse read the resolution adopted by the directors requesting an adjournment in view of the fact that it was considered not advisable at this time to announce the details of the plan for placing the preferred stock and paying the debts of the company.

After the reading, Mr. Westinghouse went on to state that he thought in justice to himself and the other stockholders, the action of the directors should be ratified. He said that if the plans of the company were made public at present, it might interfere with negotiations and injure the present bright outlook. He spoke very encouragingly, and said that so far his negotiations had been very successful, and he hoped in the very near future to be able to show by facts and figures that the stockholders would realize more from their investments than they had ever expected. At the conclusion of this brief speech, Frank Whitesell, attorney-at-law, offered a resolution to the effect that the adjournment requested be granted. This was speedily seconded and adopted without a dissenting voice. The stockholders then dispersed.

After the meeting a Pittsburgh dispatch says that Mr. Westinghouse said he could give nothing for publication save what he had told the stockholders. He said that at the meeting on the 18th inst., everything would be made public. Several stockholders when spoken to said they were satisfied to wait till the 18th. Mr. Westinghouse's encouraging remarks evidently seemed to give them renewed hope, and they all went away in good spirits.

A New York district messenger boy disappeared with $1,000 last week.

Electric Light News

—— The Fort Payne, Ala., Coal and Iron Company are about to erect an electric light plant.

—— The new Faraday Carbon Works, at Jeannette, Pa., will open about May 15, employing about 250 men.

—— The South Pittsburgh, Tenn., Electric Light and Power Company will increase the capacity of its station.

—— Shenandoah, Ia., will be illuminated by electricity. At an election a local company was voted a franchise for ten years.

—— The Bangor, Me., Electric Light and Power Company is to add an auxiliary steam power plant to be used to run its dynamos when its water power gives out.

—— The directors of the Fort Wayne Electric Company have declared a dividend of 75 cents per share, payable May 15, to stockholders of record May 9. The books will be closed from May 11 to 15, both days inclusive.

—— The Carpenter Electric Light and Power Company, of Catlettsburg, Ky., will at once put in an addition to their steam plant of 150 to 180 horse-power, and may change their present system of direct current incandescent lighting to an alternating system.

—— The defendant in the case of the People *ex rel.* the Brush Electric Illuminating Company, of New York, *vs.* Edward Wemple, as comptroller, last week made a return to the writ of *certiorari* sued out by the plaintiff requiring him to certify his proceedings in determining the tax and penalties to be paid by the relator at $10,752.50 from November 1, 1881, to and including November 1, 1888, on a valuation of $850,000, to the general term for review. The comptroller maintains that all the proceedings taken by him are valid and authorized by law and fully sustained by the facts.

—— The Edison General Electric Company was organized in August last, and purchased the Edison Electric Illuminating Company, of New York, giving stock of the new company in payment. Out of 500 stockholders in the electric light company, 496 favored the scheme, but Martin A. Frank, who owns $3,300 in stock, and others objected. He began proceedings to enjoin the transfer of the stock of the old company to the new company, and asked for a receiver of the old company, which, he says, has a large amount of securities which should be sold and applied to the payment of dividends. His motion for a receiver and injunction was argued last week, before Judge O'Brien, of the Supreme Court. In opposition, it was argued that there should not be any interference when so many favored the matter. It was also urged that the new company was paying 22 per cent. dividends, whereas the old company had not paid any. Decision was reserved.

An Interstate Association.

The Interstate Electric Light Association was permanently formed last week at a meeting held at the Hotel Anderson, Pittsburgh. Some time ago representatives of the electric light companies from surrounding towns held a meeting to discuss the project, and it was consummated at this meeting.

The association will be composed of companies in Western Pennsylvania, Eastern Ohio and West Virginia. Dr. G. M. Getze, of Tarentum, Pa., was re-elected president, and H. S. Pierce, secretary. Constitution and by-laws were adopted regulating the association, which is for the purpose of mutual benefit of the companies in comparing notes, securing the best methods and machinery, etc. It is not their intention to regulate rates or in any way control the business of the companies.

Stanley's Alternating Current Fan Motor.

Mr. William Stanley, Jr., electrician of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., has just perfected the alternating current fan motor illustrated herewith. The term "fan motor," has come to be commonly applied to distinguish small portable motors, with fan attached, from larger stationary motors, which are much used for driving fans, for the ventilation of the whole, or a large part of a building. Several very good fan motors have been devised for use on continuous current circuits, and have come into quite general use, but where alternating currents are employed, this very desirable adjunct to the lighting business has not been obtainable. Many attempts have been made to produce a motor which would run successfully on alternating currents, but for various reasons nearly all have proved unsatisfactory.

In designing his motor, Mr. Stanley determined to overcome these technical difficulties, and also to go a step farther than any one had gone in the way of making an essentially portable machine.

The most proper name for this motor would, perhaps, be "desk motor," as it is perfectly adapted for placing about on desks, tables, etc., and for nothing else.

All materials used are of the best, and the workmanship on every part where precision is at all essential, is first-class. The commutator is large, the shaft heavy, the brush holder permanent in adjustment, and a marvel of mechanical simplicity. The whole machine is particularly attractive to a mechanical eye.

Electrically, it is, for so small a machine, very efficient and perfect. Its insulation is of the best, and the amount of wire on the field and armature is extremely small. It will be seen that the general contour of the motor is such that all vital points are well protected from chance of mechanical injury. The shaft is of steel and the bearings large and self oiling.

Only 1½ amperes are required to drive the motor on a 50 volt circuit. There is no heating, no noise, except the whirring of the fan and no sparking.

The base of the motor is 3¼x5¾ inches. The fan is 6½ inches in diameter. The motor complete with fan and base weighs less than nine pounds. Another important feature is that the operation of the motor does not affect lamps which may be on the same circuit.

Lightning Rods.

The reading of Mr. Hodges' paper on lightning rods before the American Institute of Electrical Engineers, led to an animated discussion. After remarks by Mr. Wolcott, drawing an analogy between the effects by Dr. Lodge of vacillatory discharges of Leyden jars, and the lightning protector of Mr. Hodges, the latter said: I want to get a case where the conductor has gone to pieces, and where the ship has not been saved. I found this to be true in every single case of a church tower being struck where the wire runs from the bells to the clock. The wire goes, and the church-tower is saved between those two planes. Now, that is a matter of record. The ship "Jupiter" had a chain conductor, and it was dissipated; and the books say that the ship was saved in spite of the conductor being dissipated. But that is a man's opinion. What I want to urge on the Institute is simply this: That in every single case when a conductor goes to pieces everything else is saved. Can you cite a case where the conductor has gone to pieces, and there has been any destruction to the building between practically two horizontal planes passing through the upper and lower ends of that dissipated conductor? You will find that there is damage above and damage below very likely. But as I went on through the Philosophical Transactions I found one case there of a thunder-storm passing over a village (it was a century ago, or more), and the people were dependent on the church clock for the time. In the morning they did not hear the clock strike. They went up in the church tower to see what the matter was, and found the windows smashed just above the bell; found the wires running from the bell to the clock were gone, and that was all the damage done. To show how small a conductor, when dissipated, will save a house, I will cite the case of a palace in France in the early part of the century. The interior was heavily gilded. The people were sitting around on gilded sofas resting against the walls—resting against thin gilded strips. A Fellow of the Royal Society visited the palace the day after it was struck by lightning and looked over the ground, No one was killed. No damage was done to that palace as far as the gilding extended. That is, in the gilded rooms no damage was done except that the gilding disappeared; it was dissipated. When they got to the lower portions of the palace, where there was not gilt, things were smashed.

[Mr. Hodges' idea of protecting buildings is to interpose at a point between the top of the rod and the roof of the building protected a box containing some conducting substance, such as soot, which may be dissipated (see REVIEW Jan. 10, '91, p. 241).—ED. REVIEW.]

Mr. Steinmetz thought:

"Using such an interrupted conductor of small cross section, that is, of comparatively high resistance, would be liable to change the whole nature of the lightning discharge; change it from an oscillating discharge to a steady and continuous rush of current, from which must be expected quite different effects. When, for instance, you discharge a condenser by a conductor of very low resistance, you get an oscillating discharge of an extraordinary high frequency. If you increase the resistance of the conductor, the number of oscillations of the discharge decreases, it runs down quicker, until at last you reach a value of resistance where only one wave of discharge current appears; that is, the discharge of the condenser becomes steady. Now, if we can make a lightning discharge steady instead of oscillating, then we have first to expect that the electricity traverses the lightning-rod only once, slowly increasing in current strength and then decreasing again by going down to the ground; while in an oscillating discharge the current will rush to and fro through the conductor until its energy is consumed by the resistance of the lightning-rod, or by electro-magnetic radiation and reradiation from the induced currents produced by the oscillating discharge in neighboring conductors. This, perhaps, may account for some of these phenomena mentioned—that, when the lightning rod is dissipated, that is, when its resistance was very high in comparison with the quantity of electricity rushing through, there is a steady discharge and no harm done. While, when it is an oscillating discharge, the slightest irregularity will cause the discharge to "jump the track," that is, to leave the lightning-rod, which is obstructed by the counter E. M. F. of self-induction, and to spark over to metal masses of larger condenser capacity. For what I consider as the most dangerous part of lightning discharges is not the enormous voltage of the discharge, nor the strong current rushing through the lightning-rod, but the electro-magnetic field of force, which alternates with enormous frequency and reaches far out into space, from the real path or center of disruptive discharge, and thereby must cause inductive effects everywhere, which, as before said, cause not only the main discharge to spark over, but produce true secondary or induced lightning discharges. Hence, I must be very much in favor of every arrangement which is able to change the oscillating discharge into a steady rush of current. The *resistance* of the lightning-rod I consider as of subordinate importance only, except so far as carrying capacity is concerned. For of what use is a resistance as low as a few ohms, when the self-induction of the lightning-rod causes a spurious resistance of, perhaps, hundreds of thousands of ohms. Indeed, the whole resistance of the lightning circuit is so large that under any circumstances the resistance of the lightning-rod is imperceptibly small. It is not the resistance proper, but the consumption of energy by the resistance which causes the amplitude of the oscillating discharge to decrease slower or quicker until, for a very rapid consumption of energy by resistance, only one wave appears that is a steady or continuous current. This phenomenon is similar to a pendulum oscillating in a liquid; the greater the frictional resistance of the liquid the quicker the amplitude of the pendulum motion decreases, until, at last, in a very tough liquid, the pendulum comes to rest without any oscillation at all—periodically. In such a way the resistance of the conductor, by consuming the energy of the electric discharge, could change the discharge from an oscillating to a continuous one, although the whole 'resistance' has still about the same value 'infinite,' if we were allowed to speak with the usual meaning of 'resistance' of *disruptive* discharges, that we are not."

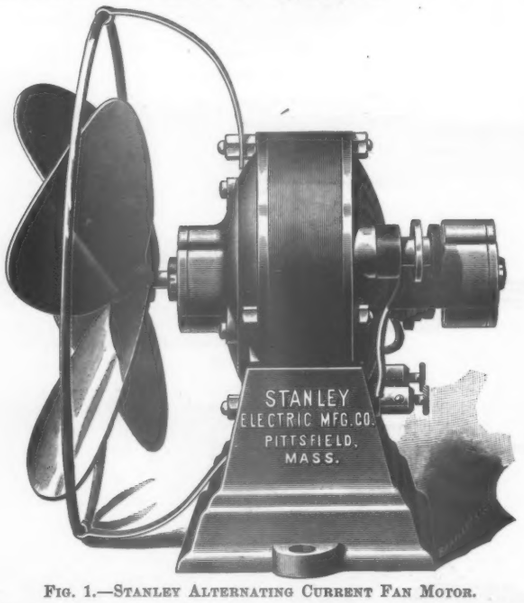


FIG. 1.—STANLEY ALTERNATING CURRENT FAN MOTOR.

Mr. Hodges said he had written Mr. Atkinson about this subject and he wrote back that they had experience with lightning-rods, and that their experience was such that they had abolished them on all factories that were insured by the Manufacturers' Mutual Fire Insurance Company. Now, in the mills there is a considerable surface of metal; and they find, as is natural, that the discharge spreads itself, probably, over the surface of this metal. At any rate, the potential was so reduced as to very materially mitigate the effects. As Mr. Atkinson put it, it spreads out over the surface of the machinery, so that no great damage is done. But they have taken off their old rods.

The North Western Thomson-Houston Company.

At the annual meeting of the stockholders of the North Western Thomson-Houston Electric Company, of St. Paul, held Thursday, May 7, the following officers were elected for the ensuing year: E. R. Gilman, president; H. M. Byllesby, vice-president; W. G. De Celle, secretary; J. B. Tarbox, treasurer; B. F. Meek, acting treasurer. Directors—E. R. Gilman, W. G. De Celle, H. M. Byllesby, V. N. Watkins, J. B. Tarbox, E. I. Garfield, B. E. Sunny.

The business of last year was about $2,000,000. Capital paid up, $750,000; beside this there is a good-sized surplus. This company was originally started by Mr. E. R. Gilman in 1887. Mr. Gilman has been president of the company since its organization.

Magnetic Shunts.

A COMMUNICATION TO THE BRITISH PHYSICAL SOCIETY BY PROF. S. P. THOMPSON.

After referring to a few instances in which magnetic shunts are employed, as, for example, the ordinary magnetic medical coil and Trotter's constant current dynamos, he said, that the particular property he wished to speak of was, the time taken for such a shunt to lose its magnetism as compared with the other branch of the magnetic circuit. If these times were very different, unexpected results might be produced, and these might be regarded as being due to a kind of magnetic time-constants. Short pieces, as was well known, demagnetize much more rapidly than long ones, particularly if the latter form, or be part of, a closed magnetic circuit. Hence, in alternators, such as Kingdon's keeper dynamo, in which both magnets and armatures are stationary, it was important that the revolving keepers should be short. The most important application of a magnetic shunt occurred, he said, in d'Arlincourt's relay, described in Vol. 4, Journal of the Society of Telegraph Engineers and Electricians, and shown diagrammatically in the accompanying illustration. In this relay the polarised tongue T plays between two projections *a* and *b* near the yoke Y, and it is claimed to have a quicker action than ordinary kinds. The reason of this the author explained as follows: When a current flows through the coils the greater part of the magnetic lines pass through the yoke but a few leak across from *a* to *b* and move the tongue against the contact P. On stopping the current the magnetism in the extremities A and B dies away much more rapidly than in the yoke, consequently the direction of the field between *a* and *b* is reversed and the tongue T thrown back against the stop Q.

Prof. Perry asked if any experiments had been made to test whether the throwing back actually occurred. He also enquired whether such actions would be augmented or otherwise by having a thick copper tube round the yoke, or by laminating the iron.

Mr. Blakely asked if placing a yoke across A B would not improve the action.

The president said he would be glad to know whether the relay was any more sensitive than an ordinary one as regards the ampere-turns or the watts required to actuate the instrument. In India he remembered that they used inductive coils shunting the ordinary relays in order to expedite the action and to avoid confused signals arising from the electrostatic capacity of long lines.

In reply, Prof. Thompson said he had tried an experiment on a horse-shoe electromagnet, and found evidence of throwing back when working near the bend or yoke. Putting a yoke across A B would, he thought, tend to neutralize the effect desired.

Increased Factory Facilities of the Schuyler Electric Company.

The well-known Schuyler Electric Company, of Middletown, Conn., have been compelled to greatly increase their already large manufacturing facilities, and have just completed an addition 207 feet long by 60 feet wide, three stories high, immediately adjoining their present offices and factory. The new factory is fitted up with sprinklers and complete fire apparatus, and when completed will be one of the strongest and most complete buildings in the city. A new four-valve Russell engine, 150 horse-power, has been put in, and a complete electric lighting plant of the Schuyler system.

In addition to continuing the extensive manufacture of the excellent Schuyler apparatus, the Schuyler Company expects to begin the manufacture at an early day of general electric light and power supplies, and will, on and after July 1st next, employ some 600 men. Whittier elevators have been put in and a 10-ton travelling crane will be one of the conveniences. The steam heating apparatus and sprinklers were put in by Fosgate & Bishop, of New Haven.

The present very convenient offices of the company will not be changed. Mr. Charles E. Dustin, the energetic head of the Schuyler Company, and his co-workers, Messrs. Elliott and Dalzell, are to be congratulated on the very pronounced success they have won for the Schuyler Company, which is particularly evidenced by the increase in manufacturing facilities the business now demands.

Patent Rights of Employer and Employe.

An interesting patent case was decided not long ago by the Supreme Court of the United States in which the rights of employers with respect to inventions made by their employés, at the expense and in the time of the employer, are set forth.

It appears that during the years of 1867 and 1868, Spencer M. Clark was in the employ of the government as Chief of the Bureau of Engraving and Printing. While so employed he was called officially into consultation with the Secretary of the Treasury, commissioners, and the committee of the House of Representatives, and to him was assigned the duty of devising a stamp. He devised a self canceling revenue stamp for the prevention of fraud, which in his official capacity he recommended and which was adopted without any understanding concerning the right of the government to use the invention. He gave no notice that he would take out letters patent, but stated that being employed by the government, he should make no charge for the right. The government make large quantities of these stamps.

On December 21, 1869, a patent was granted to Solomon, as assignee of Clark, for the invention and suit was brought against the government.

In the Court of Claims judgment was entered in favor of the government. From such judgment an appeal was brought to the Supreme Court.

The Supreme Court, affirming the Court of Claims, held:

The government has no more power to appropriate a man's property invested in a patent than it has to take his property invested in real estate; nor does the mere fact that an inventor is, at the time of his invention, in the employ of the government transfer to it any title to or interest therein. An employé, performing all the duties assigned to him in his department of service, may exercise his inventive faculties in any direction he chooses, with the assurance that whatever invention he may thus conceive and perfect is his individual property. There is no difference between the government and any other employer in this respect. But this general rule is subject to these limitations:

If one is employed to devise or perfect an instrument, or a means for accomplishing a prescribed result, he cannot, after successfully accomplishing the work for which he was employed, plead title thereto as against his employer. That which he has been employed and paid to accomplish becomes, when accomplished, the property of his employer. Whatever rights as an individual he may have had in and to his inventive powers, and that which they are able to accomplish, he has sold in advance to his employer.

So, also, when one is in the employ of another in a certain line or work, and devises an improved method or instrument for doing that work, and uses the property of his employer and the services of other employés to develop and put in practicable form his invention, and explicitly assents to the use by his employer of such invention, a jury, or a court, trying the facts, is warranted in finding that he has so far recognized the obligations of service flowing from his employment and the benefits resulting from his use of the property and the assistance of the coemployés of his employer, as to have given to such an employer an irrevocable license to use such an invention.

The case of McClung *vs.* Kingsland (1 How., 202) is in point. In that case, Harley was employed by the defendants at their foundry in Pittsburgh, receiving wages from them by the week. While so employed, he claimed to have invented the improvement pateuted. The experiments were made in the defendants' foundry, and wholly at their expense, while Harley was receiving his wages, which were increased on account of the useful result. Harley continued in their employment on wages until January or February, 1835, during all of which time he made rollers for them. He often spoke about procuring a patent, and prepared more than one set of papers for the purpose; made his application on February 17, 1835, for a patent. It was granted on the 3d of March, and assigned to the plaintiffs on the 16th of March, pursuant to an agreement made in January. While Harley continued in the defendants' employment, he proposed that they should take out a patent, and purchase his right, which they declined. He made no demand on them for any compensation for using his improvement, nor gave them any notice not to use it, till, on some misunderstanding on another subject, he gave them such notice, about the time of his leaving their foundry, and after making the agreement with the plaintiffs, who owned a foundry in Pittsburgh, for an assignment to them of his right. The defendants continuing to make rollers on Harley's plan, the action was brought in October, 1835. The court left it to the jury to decide what the facts of the case were, but, if they were as testified, charged they would fully justify the presumption of license or grant to the defendants to use the invention; and the facts amounted to "consent and allowance of such use," and show such a consideration as would support an express license or grant, or call for the presumption of one to meet the justice of the case, by exempting them from liability, having equal effects with a license, and giving the defendants a right to the continued use of the invention.

PERSONAL.

Mr. W. D. Sargent, of Brooklyn, was last week elected a director of the New England Telegraph and Telephone Company.

Mr. C. G. Ferguson, formerly with *Electric Power*, now represents the *American Journal of Railway Appliances*, with offices in the *World* Building, New York.

Mr. E. C. Kilbourne, of Seattle, Wash., is visiting the city and looking into electrical matters in the East. Mr. Kilbourne reports electric work in his city as quite active.

President S. Endicott Peabody, of the American Loan & Trust Company and Thomson European Electric Welding Company, sailed for London last week, in the interest of the latter company.

Mr. Alex. D. Anderson, special commissioner of the World's Columbian Exposition, has located the Eastern headquarters of the Exposition in the Stewart Building, Broadway and Chambers street, New York, where any desired information about Fair matters may be obtained.

Mr. W. W. Jacques, of the American Bell Telephone Company, and a gentleman well known in electrical circles, was reported to have been mobbed in Florence, Italy, last week, while out driving with his daughter. Later cable messages state the mobbing of Mr. Jacques was not so serious as at first supposed, and the affair occurred in this manner: Mr. Jacques and his family were out riding, and, happening to drive through a street where some arrests were being made, and stones and other missiles being thrown at the arresting party, their equipage was struck by some of the flying bricks. One of the stones crashed through a window of the carriage with terrific force and struck one of the occupants.

A New Form of Standard Cell.

BY CARL HERING, BEFORE THE FRANKLIN INSTITUTE, MAY, 1891.

The standard cells used at present may be said to be limited to the Clark cell and the Daniell cell. Each one of these has its specific advantages and disadvantages. The Clark cell is always ready for use, but is difficult to make, is affected by temperature, and has the important disadvantage that if by accident it is short-circuited it polarizes so rapidly and so much, that it is of no use at all until it has been allowed to rest and recuperate for some time. Such accidental short circuits are not unlikely to occur, and they may furthermore occur, by the crossing of two wires, for instance, without the knowledge of the operator, thus making it possible that the measurements made with it are incorrect. The Daniell cell, on the other hand, does not polarize at all; it may be short-circuited and used almost immediately afterwards; furthermore it is very easy for any one to construct a Daniell, and it is practically independent of temperature. But it has the important disadvantage that it must be freshly set up just before using and cannot be kept standing. In their good and bad qualities, therefore, the two cells are diametrically different.

FIG. 1.—STANLEY ALTERNATING CURRENT FAN MOTOR.

The object of the present form of cell is to try to combine all these good points in one and the same cell. As the polarization of the Clark cell is an inherent fault and cannot be remedied, there remains only to endeavor to devise a form of Daniell which is always ready for use. The difficulty is due to the fact that there are two liquids which must be in contact with each other; these liquids will tend to mix, and if they mix to the slightest extent only, the cell can no longer be used as a standard. The difficulty, therefore, resolves itself to a means for enabling two liquids to be in contact without mixing. Numerous forms of Daniell cells have been devised with this object, but they accomplish it only in a degree, as, for instance, by capillary tubes, porous diaphragms, etc., all of which, however, do not prevent mixing, but merely diminish the rapidity of the mixing.

In a number of these forms, in which two bottles or reservoirs are connected together by a tube, the mixing takes place quite rapidly unless the pressure of the liquid is exactly the same in both bottles, a condition not always easily complied with.

Some time ago the writer had occasion to use a cell of this form devised by Prof. Barker, which consisted of two bottles containing the two liquids with their respective electrodes, the bottles being connected at their bottom by a small tube with a stopcock. This cock was opened only during the moment when the cell was being used. But even during a few seconds no small amount of mixing took place, especially if the pressure was different in the two bottles. It is very difficult to avoid the latter, owing to the different specific gravities of the liquids and their different heights in the two bottles. The writer, therefore, modified this form by inserting two stop-cocks in this tube and allowing the portion of the tube between the two cocks to communicate directly with the air. By this means the liquids, which mix at their contact, are allowed to drain off as rapidly as they mix. As there is an outward flow of the liquids through the cocks, the mixed liquids cannot pass back into the bottles. The liquids in contact with the electrodes will, therefore, always remain pure. To prevent too rapid a flow, which would needlessly waste the liquids, some filter paper, cotton or asbestos, is packed into the tubes. The intermediate tube may be drained completely. There is always a film of liquid sufficient to answer for a contact if the cell is used on open circuit, which is the only way any standard cell should be used. It was even found that the film of liquid through the cocks when closed was sufficient to give an electromotive force which, however, falls as soon as the slightest current is allowed to flow.

The internal resistance of such a cell is naturally quite high, from 10,000 to 20,000 ohms, but this is no disadvantage for the usual class of open-circuit testing.

The electromotive force of a Daniell cell, according to a report of Dr. Fleming, is as follows: When the specific gravity of the zinc solution is 1.2, and that of the copper is 1.2, when the zinc is amalgamated, and the copper is freshly electroplated with an untarnished, salmon-colored coating, having no brown spots, the electromotive force is 1.105 true volts at about 16°C. The temperature correction is negligible. The solutions and metals must be perfectly pure, and the solutions made with distilled water and filtered, being diluted to the required amount after filtration.

Such a cell may be kept standing indefinitely, and is always ready for use. The only remaining objection is that the copper electrode does not remain clean. It should be freshly electroplated before using, which is readily done in a test tube with a platinum anode. To overcome this, the writer suggests to amalgamate the copper, and when not in use to keep it in a tube of mercury. Whether this introduces other objections has not yet been tested.

Another modification suggested is to place in the bottom of the bottle containing the zinc solution, a quantity of pure zinc scrap, not in contact with the electrode. Similarly, copper scrap in the other bottle. Should any mixture of the liquids take place, they will be freed of their impurities by these metals, which, not being in contact with the electrodes, will not affect the electromotive force.

In experimenting with this cell a curious phenomenon was noticed, which does not appear to be known. It was found that the slight pressure produced in the bottles by inserting the corks at the top, produced decided differences in the electromotive force of the cell; this was noticed for each of the liquids, and was different in the two cases.

It was, therefore, found essential to use a cork with a hole through it, so as to prevent this pressure from being exerted. The effect of this pressure has since been investigated by a very extended and interesting set of experiments made by Prof. Hermann Hering, and will form the subject of a paper to be read by him following this one.

The Chicago Rubber and Mill Supply Company, 312 Dearborn street, has been incorporated. This company succeeds the Thos. L. Johnson Company, Mr. Johnson retaining the position of secretary and general manager. The new company starts out with the brightest prospects. They have been appointed agents for the Card Electric Company, of Cincinnati; also agents for the Erie Rubber Company, Jas. Davis Belting Company, American Steam Packing Company and the Cowles "Reliable" sectional wood pulleys.

KINDRED INTERESTS

The Jewell Belting Company, Hartford, Conn., have issued a pamphlet about leather belting, containing a few general rules for its care and use. It should be in the hands of every belt user.

The Central Electric Company report large sales of the Packard incandescent lamp. They find that the lamp is very well received by users and is considered by everybody one of the very best incandescent lamps ever made.

Burton Electric Company.—Mr. S. D. Greene, of the Edison General Electric Company, has been elected and has accepted the position of consulting electrician of the Burton Electric Company, of Richmond, Va. Mr. Greene has for a number of years taken a great interest in the heating of street cars by electricity, and the company deems itself fortunate in having secured his services.

Frank Ridlon & Company, 196 Summer street, Boston, have sent us an excellent photograph showing the offices of the Baxter Electric Motor Company, the Wright Electrical Engineering Company and Frank Ridlon & Company, all at 196 Summer street. These offices are handsomely furnished and well arranged. The photograph is handsomely framed and will occupy a space on the wall of our sanctum.

The Okonite Base Ball Club, which consists of the employés of the Central Electric Company, are whitening up their belts and getting in trim for the Summer's campaign. They have already secured a diamond in Jackson Park, near the World's Fair grounds, for Saturday afternoons in July and August, and will then be ready to meet all comers. This club covered itself with glory in the memorable contest with the Kerite Club and it expects to present some very brilliant work the coming Summer.

The Properties of Aluminium.

In the discussion which followed the reading of Mr. Brown's paper (published in the REVIEW of May 2, '91.) on aluminium before the American Institute of Electrical Engineers some interesting points in relation to this interesting metal were brought out.

Prof. F. B. Crocker, stated that it was a very common mistake to attribute to aluminium itself the tensile strength of aluminium bronze, which exceeds that of wrought iron, and is about as high as good specimens of steel. It is really one of the most tenacious metals known, but its composition is about nine parts of copper to one part of aluminium; yet its tensile strength is almost invariably attributed to pure aluminium, having a specific gravity of 2.6, which is only one-third that of iron. They take the low specific gravity of pure aluminium and the high tensile strength of aluminium bronze. As a matter of fact, the specific gravity of aluminium bronze is higher than that of iron. Therefore, we do not have lightness combined with high tensile strength. Turning again to aluminium itself, its tensile strength is about 26,000 pounds per square inch; in other words, about one-third that of iron. This just balances the difference in specific gravity, but still leaves the advantage in favor of iron, because one-third of the volume has the same strength and the same weight as a rod of aluminium. Now, the same exaggeration is applied to its other qualifications; for example, its chemical properties. Aluminium bronze is remarkably free from tarnishing. A bright surface of aluminium bronze may be exposed to the atmosphere for several months and retain its polish. That property is attributed to aluminium itself. Aluminium, as Mr. Brown said, is not particularly liable to corrosion, but if it is subjected to salt water or alkaline water, or even ordinary moist air, it does tarnish and oxidize rapidly. Salt water is quite hurtful to it. Therefore, freedom from oxidation is another property that is wrongly attributed to it; and the objection to all this is that it gives a very wrong impression in regard to what would otherwise be a good and legitimate object of admiration. In regard to its real properties, he thought the pure metal entirely too soft for structural purposes, as it can easily be cut with a knife; as to its chemical properties it oxidizes with about the same ease as zinc, tin and iron. Is eagerly attacked by acids. It is not much affected by sulphur or sulpheretted hydrogen, which is a great advantage. It is very freely dissolved by alkalies, whereas, most other common metals are not. In an ordinary alkaline solution, aluminium is dissolved, as most metals are, in acids, with the evolution of hydrogen. This is quite a serious disadvantage for a common metal, which is liable, for example, to have soap used upon it. We do not expect metals to be attacked by alkalies.

Its conductivity is about twice that of copper, weight for weight. The increase of size to get this conductivity, however, would preclude its use in place of copper in rubber insulated wires on account of the increased expense of insulation. The electrical process would undoubtedly monopolize its manufacture, because it offered the only successful way of reducing it; the only competing chemical process being by use of sodium, which is in reality electrical because the sodium is made electrically.

Dr. Samuel Sheldon thought its resonant properties would open a use for it in making bells, but Mr. Brown explained that although it had a fine tone in boxes this property did not follow when cast or rolled into the shape of bells, although in gongs it has a fairly good tone.

WANTED.—A young man of good address, to look after sales of insulated wire. Address, with reference, **"C. P."** Care ELECTRICAL REVIEW, NEW YORK.

"A BIG HIT!"

AN ADJUSTABLE HAMMER.

WE CLAIM this is the Best, Cheapest, Loudest Ringing and Handsomest Electric Bell in the United States.

WRITE FOR PRICES

(Patent Applied For)

HAY HORN MFG. CO., 63 South Canal Street, CHICAGO.

NEW CATALOGUE READY. Eastern Agt., Jas. H. Mason, 120 Park Ave., B'klyn, N. Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

MANUFACTURED BY

Charles A. Schieren & Co.,

45, 47, 49, 51 FERRY ST., COR. CLIFF ST.

BRANCHES:

BOSTON, 119 HIGH STREET.
PHILADELPHIA, 226 NORTH 3d STREET.
CHICAGO, 46 SOUTH CANAL STREET.

THE LAW

Double Cylinder Battery.

Surface of negative element and quantity of solution double that found in any other open circuit cell.

Weigh carefully these advantages.

Its sale has steadily increased for ten years.

LAW TELEPHONE CO.,

Sole Makers,

87 JOHN STREET, NEW YORK.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 56 in. x 18 ft.; 72 in. x 20 ft.; 108 in. x 22 ft. Fox Lathes; 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes; 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.

Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 72 in. x 60 in. x 15 ft.; 72 in. x 60 in. x 20 ft.

Friction Shapers, 15 in., 16 in., 20 in., 22 in., 23 in.

Crank Shapers, 6 in., 8 in., 10 in., 12 in., 15 in., 16 in., 20 in., 24 in., 28 in.

Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.

Screw Machines, Nos. 5, 6, 7, 8, Power Feed.

Presses, Nos. 51, 52, 53, Ferracute, Nos. 1, 2, 3, Stiles & Parker.

20 Lincoln Pattern Millers, No. 2.

Hand Millers, Nos. 1 and 2. 3 Cam Cutters.

Bolt Cutters, ¼ in. to 1 in., ½ in. to 2 in.

2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.

1 New Horizontal Boring Machine. Newark Machine Tool Co.

Send for May List of New and Second-Hand Machinery.

PRENTISS TOOL & SUPPLY CO., P. O. Box 3362. 115 Liberty Street, New York.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.

IF YOU want anything pertaining to electric machinery, send us your inquiries.

FRANK RIDLON & CO.,

Dealers in New and Second-Hand

Electric Light & Power Machinery,

196 SUMMER STREET, BOSTON.

— THE —

REMINGTON

Standard Typewriter.

Presents the practical results achieved by the best inventive and mechanical skill, aided by capital and the experience gained during the FIFTEEN YEARS in which it has been the

STANDARD WRITING-MACHINE OF THE WORLD!

Send for Illustrated Catalogue.

Wyckoff, Seamans & Benedict,

327 BROADWAY, N. Y.

"Magnetic Vane" Ammeters and Voltmeters.

THE best and cheapest instruments for Central Stations, Isolated Plants, Marine Installations and Electric Railways. Special Contracts made with Manufacturing Companies for supplying Ammeters and Voltmeters for use with their plants.

Correspondence Solicited.

Send for Descriptive Circular 235, and Catalogue I-66.

QUEEN & CO., Makers, Philadelphia.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MAY 5, 1891.

451,445 Secondary battery; Truman H. Aldrich, Cincinnati, O.

451,449 Telegraph repeater; Albert C. Booth, Cedar Rapids, Ia., assignor of one-half to William P. Ward, same place.

451,491 Electric railway truck; Walter H. Knight, Boston, Mass.

451,514 Electric brake; Joseph M. Payne, Cressona, Pa.

451,520 Electric meter; Edwin W. Rice, Jr., Lynn, Mass.

451,540 451,541 Secondary battery; George A. Washburn, Cleveland, O.

451,559 Electric motor; Walter E. Heyer, Newburg, N. Y.

451,574 Dynamo-electric machine; Lewis C. Rice, Denver, Colo.

451,586 451,587 Insulated electric conductor; James B. Williams, Oakland, Cal.

451,605 Electric conductor; Joseph F. Andrews, Westminster, England.

451,614 Underground electric wire conduit; Henry B. Cobb, Wilmington, Del.

451,634 Telephone receiver: William S. Corwin, Newark, N. J.

451,637 Electric railway system; Charles K. Harding, Atlantic, Ia.

451,649 Electric stop motion; Charles A. Dayton, Preston, Conn.

451,656 Socket for incandescent lamps; Samuel Deacon, Lynn, Mass., and Merle J. Wightman, Hartford, Conn., assignors to the Thomson-Houston Electric Co., of Connecticut.

451,692 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Co., Boston, Mass.

451,696 Switch for overhead electric conductors; John Kuehnle, Detroit, Mich., assignor of one-fourth to Edward Martyn, same place.

451,700 Dynamo-electric machine; Lawrence N. P. Poland, Cincinnati, O.

451,730 Pole for electric lines, etc.; John R. Fletcher, Dayton, O., assignor to the Electrical Supply Co., Chicago, Ill.

451,732 Electric Lighting Apparatus; Budd J. Jones, Chicago, Ill.

451,754 Ship telegraphic apparatus; William Chadburn, Liverpool, England.

451,786 Method of operating reciprocating electric engines; Chas. J. Van Depoele, Lynn, Mass.

451,815 Conduit system for electric railways; William H. Ford, St. Louis, Mo.

451,832 Electric railway pole; Foster Milliken, New York, N. Y.

451,870 Electric motor; Ernest M. G. Hewett, Boston, Mass., assignor to Albert L. Jewell, same place.

451,872 Electric motor; Frank M. La Bolteaux.

451,894 Electric motor or dynamo-electric machine; Schuyler S. Wheeler, New York, N. Y.

451,894 Electric motor or dynamo-electric machine; William F. Collins, Chicago, Ill., assignor, by mesne assignments, to the Crocker-Wheeler Electric Motor Co., New York, N. Y.

451,902 Fire alarm telegraph apparatus; Joseph W. Stover, Newtonville, Mass.

Address, for Circular of Styles and Prices,

JARVIS B. EDSON,

87 LIBERTY STREET, NEW YORK.